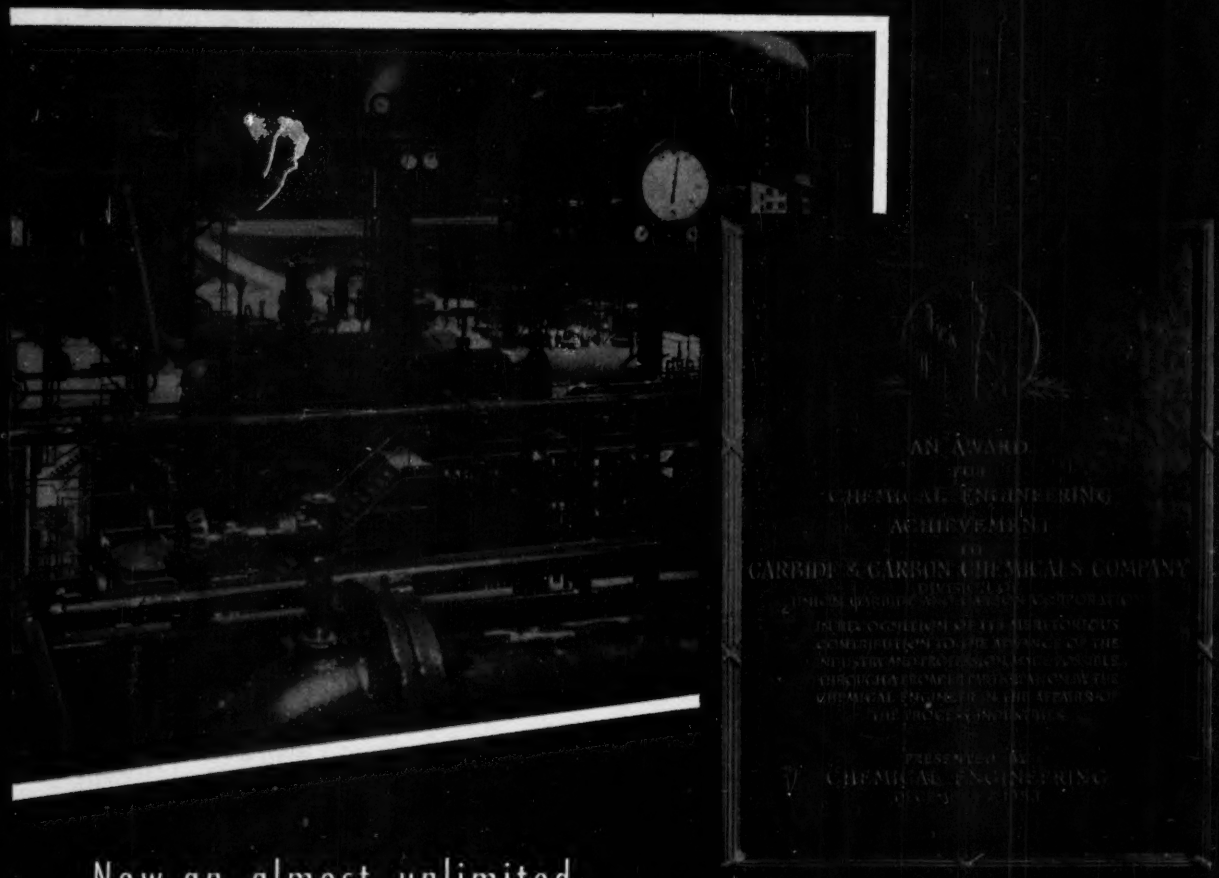
Chemical Engineering

DECEMBER
1953



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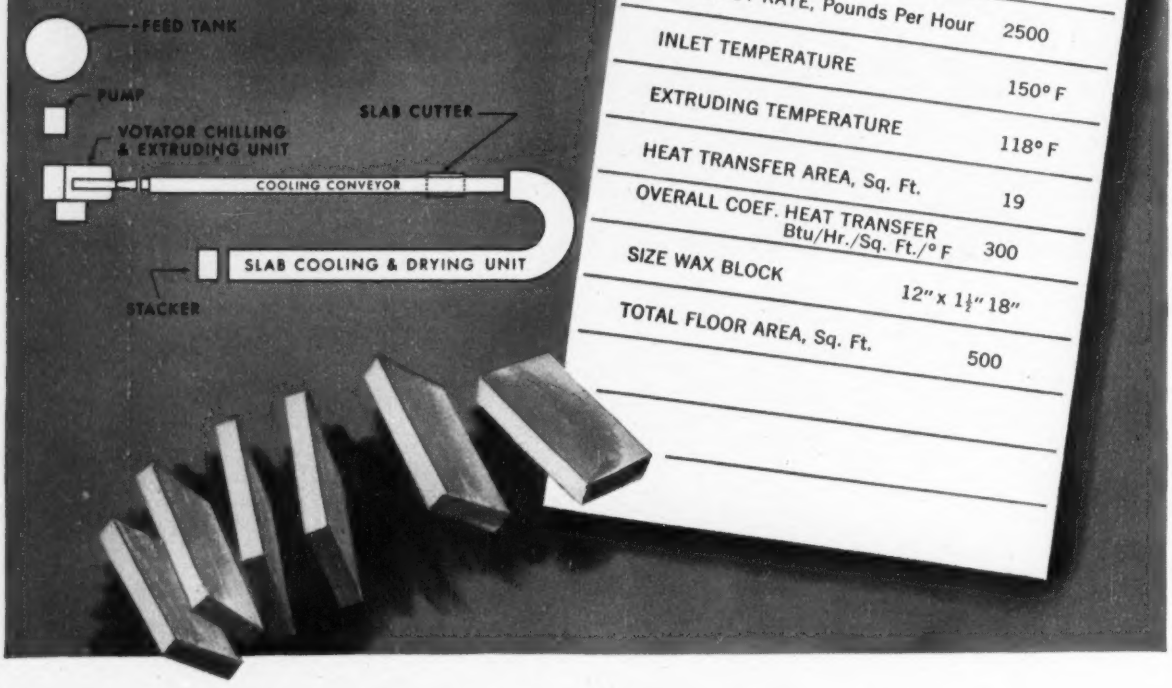

WAX PROCESSING DATA

MELTING POINT	130° F
SPECIFIC GRAVITY	.85
THRUPUT RATE, Pounds Per Hour	2500
INLET TEMPERATURE	150° F
EXTRUDING TEMPERATURE	118° F
HEAT TRANSFER AREA, Sq. Ft.	19
OVERALL COEF. HEAT TRANSFER Btu/Hr./Sq. Ft./° F	300
SIZE WAX BLOCK	12" x 1½" 18"
TOTAL FLOOR AREA, Sq. Ft.	500

COOLS . . . EXTRUDES . . . CUTS 2500 pounds wax per hour with Votator® PROCESSING APPARATUS

The data above was recorded in the continuous production of paraffin wax with VOTATOR Processing Apparatus. This is but one application of this automatic equipment in the cooling, extruding and cutting of crystalline and amorphous materials. Others: gelatins, glues, greases, soaps and stearic acid. Shapes include blocks, tubes, noodles and pellets.

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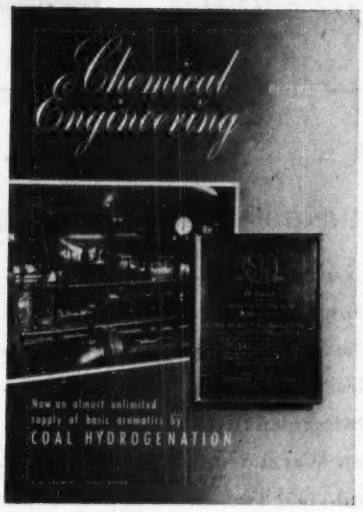
GUIDED TOUR

JOHN R. CALLAHAM, EDITOR



Hitting Close to 40,000

A couple of months ago CE's paid circulation topped 38,000 to reach a record high. The net gain this year alone will hit close to 1,000 subscribers. Our paid circulation has just about doubled within ten years.

Naturally we're a bit proud of these figures. To us they represent acceptance by chemical engineers of the job we're doing and of the changes we're making. We're proud of that acceptance—and we intend to keep on improving, too!

There's another reason why we like to point to that 38,000 figure. CE's paid circulation (net paid as the Audit Bureau of Circulation calls it) is by far the largest of any monthly chemical publication in the U.S.—in the world, probably.

Some 74 percent of our subscribers work for chemical manufacturing or processing firms. Another 13 percent are consultants or with independent laboratories. About 3 percent are students; less than 3 percent are professors or instructors.—JRC.

. . . Coal hydrogenation, top engineering feat, heralds new era for aromatics.

Carbide's researchers and engineers spent 17 years and $20 million to put over the first commercial process for getting chemicals directly by hydrogenation of coal.

"Top achievement of the year," voted 77 senior chemical engineering educators in giving Carbide the coveted 12th Award for Chemical Engineering Achievement.

Here's Editor Kirkpatrick's behind-the-scenes story of how—and why—Carbide did it, what coal hydrogenation can mean to U.S. industry (*Special Article*).

Now, a primer of valves and piping!

Here it is: A 24-page rundown (Author Olive calls it a primer) of what's what in valves, piping and fittings used in processing plants (*Feature Report*).

Need a nomograph for batch cooling?

If so, here's one developed by Engineer Seco that (1) compares sets of conditions,

Please turn page

GUIDED TOUR

(2) determines areas for submerged coils, (3) gives temperature any time in the cycle (*Article*).

Time to shut down that old plant?

Maybe. Maybe not. Either way, Author Williams sheds light on those big factors you'll have to weigh carefully: overhead, operating investment, returns (*Article*).

Does erosion chew up your pumps?

A simple bypass arrangement can stop it—and fast. Engineer Edwards tells why it happens, what you can do to prevent it now (*Article*).

Your refresher on compression.

Engineers are giving more and more attention to high-pressure processes, hence to compression. This month the Corrigan-Johnson team start their popular three-part series on the fundamentals of com pression and expansion (*Refresher*).

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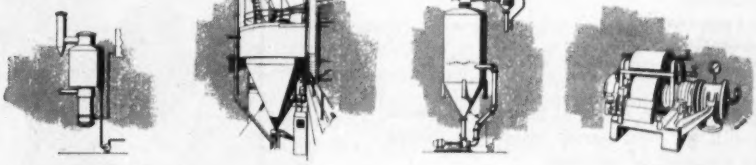

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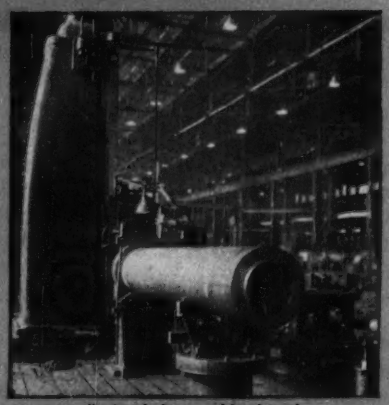
You can count on it . . . Grinnell shop fabricated piping *guarantees* maximum quality and economy.



Heavy wall pipe being machined to the proper welding bevel on a post mill

Welding (induction heating coils in place for preheat, welding heat and stress relieving.)

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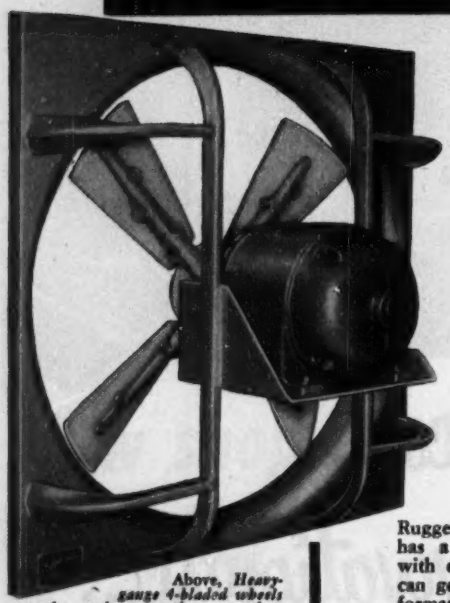

Above, Heavy-gauge 4-bladed wheels for safe operation at tip speeds up to 13,000 fpm are characteristic of the sturdy construction of Heavy-Duty "NV" Propeller Fans.

- **Many sizes, to 90,000 cfm!**
- **Free Air or pressures to 1"!**
- **Easily installed "packages"!**

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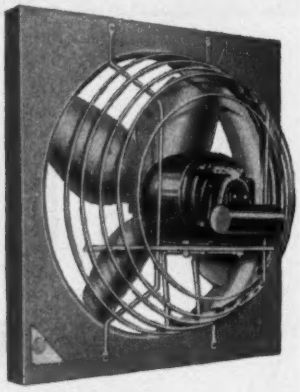
Rugged, attractive and eye-appealing, this fan has a steep pressure characteristic combined with efficient free-air performance! Thus, you can get stable, efficient and high capacity performance from this fan in simple wall installations or ventilating systems with ¼" to ½" s.p. The rigid, welded motor-side wire guard is also a firm motor support. May be had in protective coatings, Stainless Steel, #3S Aluminum or Everdur brass for corrosive and/or explosion-proof applications. 8" to 24" sizes. WRITE FOR BULLETIN 3865.



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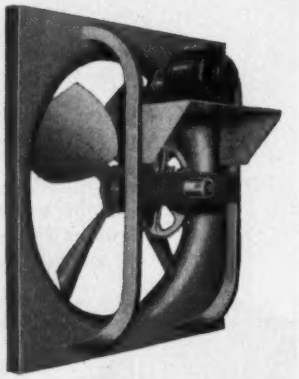

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Carnallite	Sodium Bichromate
Cellulose Acetate	Sodium Carbonate
Chromium Oxide	Sodium Chloride
Coal, bituminous and anthracite	Sodium Fluoride
Coffee	Sodium Hydroxide
Copper Sulphate	Sodium Nitrate
Copperas	Sodium Nitrite
Corundum	Sodium Stannate
Cryolite	Sodium Sulphate
Di-Sodium Phosphate	Sodium Sulphite
Ethyl Cellulose	Sodium Thiosulphate
Feldspar	Solvent Extractions
Fish Meal	Starches
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Flotation Tails	Synthetic Resins
Fluorspar	Tallow
Foundry Sands	Tartaric Acid
Garnet	Tin Ore
Gland Extracts	Titanium Dioxide
Glauber's Salt	Tri-Sodium Phosphate
Glutamic Acid	Tungsten Salts
Hexachlorethane	Ultramarine Pigment
Hexamine	Vinyl Acetate
Iron Ore	Vinyl Chlorite
Iron Oxide	White Lead
Langbeinite	Xylenes
Lead Arsenate	Zinc Chromate
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Lime Mud	Zirconium Oxide
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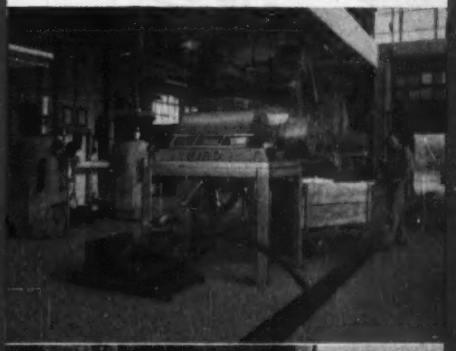

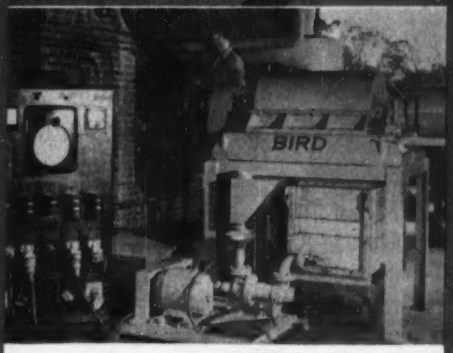

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SODIUM DISPERSIONS

TABLE OF CONTENTS

SODIUM DISPERSIONS
Definition, Properties and Uses

AVAILABILITY

PREPARATION OF SODIUM DISPERSIONS
Laboratory "Dispersator" Unit
Modified Waring Blender
Gear Pump Dispersion Unit
Production Scale Dispersion Unit

SODIUM DISPERSION FORMULATIONS

HANDLING PROCEDURES

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7. Replacement of Hydrogen by Sodium
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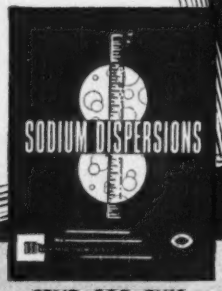

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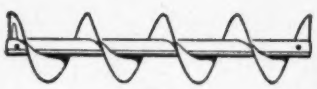

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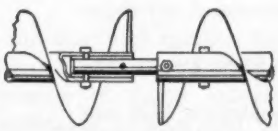
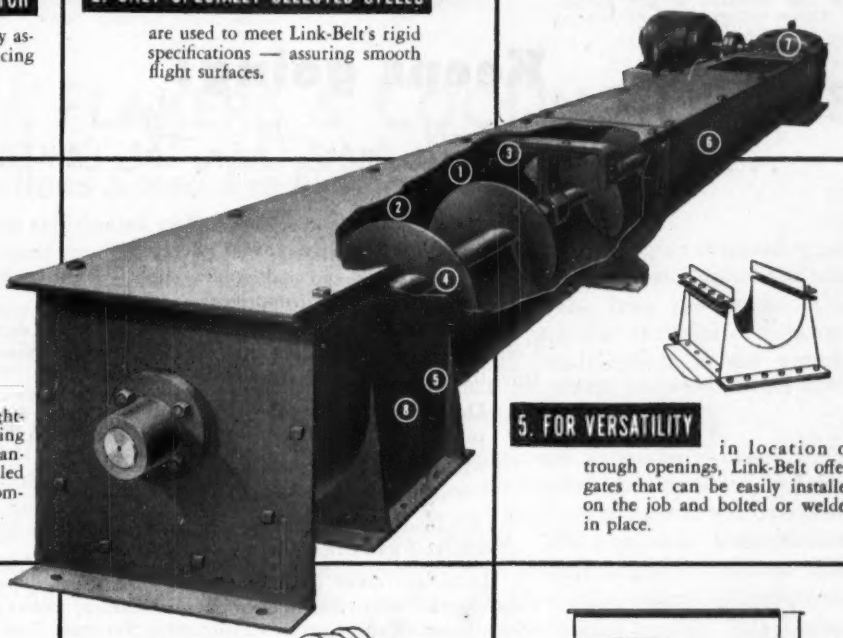
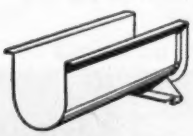
3. HERE'S A WIDE RANGE of hanger styles and mountings with various bearing materials.



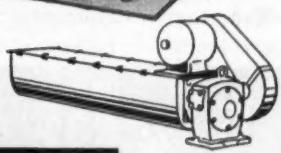
4. FOR YOUR PROTECTION straightness is checked before shipping and extra care is taken in handling and loading. Jig-drilled coupling bolt holes assure complete and easy assembly.



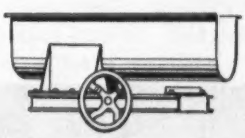
5. FOR VERSATILITY in location of trough openings, Link-Belt offers gates that can be easily installed on the job and bolted or welded in place.



6. YOU'LL DISCOVER that troughs are accurately fabricated to assure better fit of all components. Link-Belt offers a choice of metals to fit your particular application.



7. ONLY LINK-BELT builds a complete integrated line of gear and chain drives, couplings, bearings. One proved source . . . one undivided responsibility.



8. YOUR CHOICE of fixed or detachable plain discharge spouts or gates. Flat or curved slide type gates can be hand or rack-and-pinion operated.

LINK-BELT

SCREW CONVEYORS

These are only a few of the many important differences in screw conveyors. Ask your Link-Belt sales representative or distributor for new 92-page Data Book 2289.

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle; Scarboro, Toronto and Elmira, Ont. (Canada); Springs (South Africa); Sydney (Australia). Sales Offices, Factory Branch Stores and Distributors in Principal Cities. 13,278

Keeps going!

... a feature worth more than the compressor itself

Many continuous operations call for the unfailing operation of centrifugal compressors 24 hours a day, year after year.

A breakdown—no matter how slight—could mean losses greater than the original cost of the compressor.

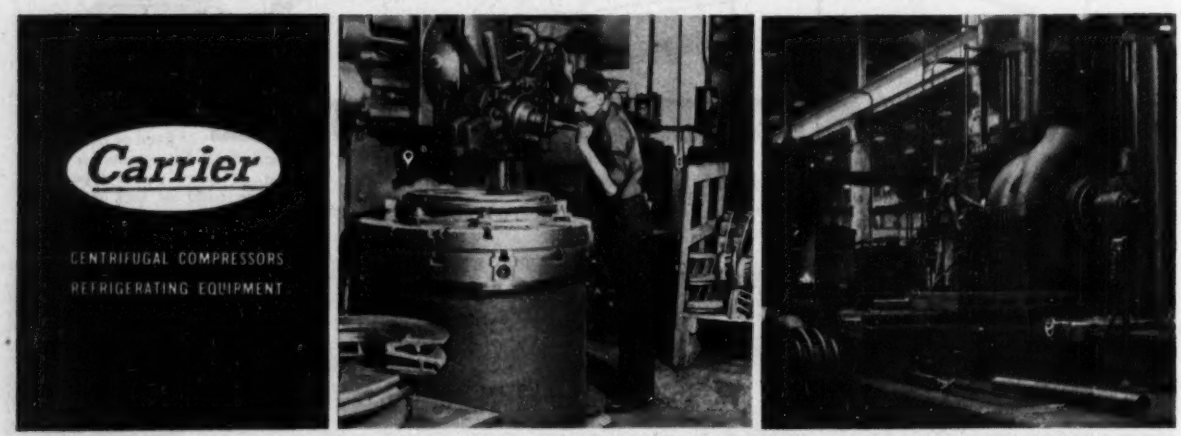
Your surest protection against stoppage is the *dependability* built into Carrier Centrifugal Compressors. It's like paid-up insurance. And it stems from three kinds of experience:

Design experience—the design for the first Carrier Centrifugal Compressors came off the drawing boards more than 30 years ago.

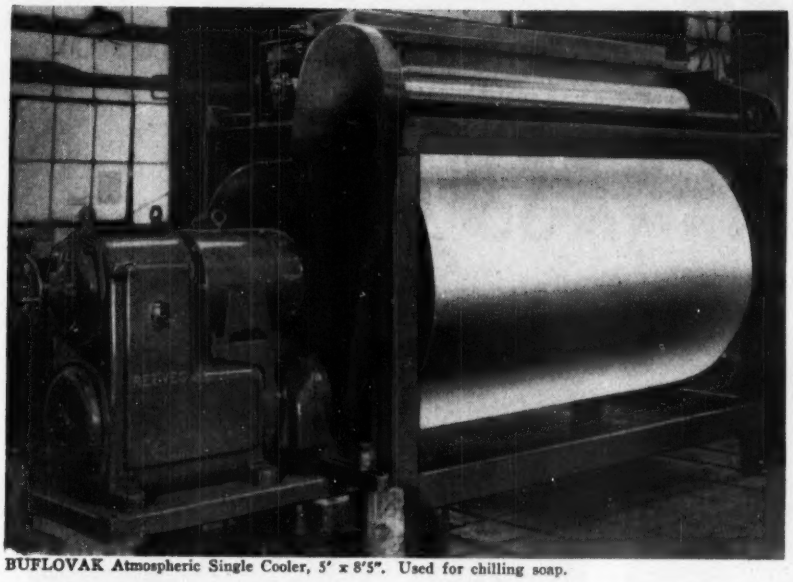
Manufacturing experience—Carrier has built some 2500 multi-stage centrifugal compressors; more than anyone else.

Application experience—Carrier Compressors have compressed more kinds of gases than any other manufacturer's.

There are other good reasons for the great dependability of Carrier Centrifugal Compressors—clear-cut, mechanical reasons. May we tell you about them? Write, Carrier Corporation, Syracuse, New York.



In the world's largest manufacturing facilities devoted to building centrifugal compressors, skilled craftsmen with years of experience assemble Carrier Compressors with watch-like precision.



BUFLOVAK Atmospheric Single Cooler, 5' x 8'5". Used for chilling soap.

BUFLOVAK BUILDS

EVAPORATORS

Low-Temperature
By-Product Recovery
Chemicals
Food Products
Crystallization

DRYERS

Vacuum Double Drum
Vacuum Rotary
Pilot Plant
Atmospheric

PROCESSING KETTLES

Mixers
Impregnators
Dopp Kettles
Solvent Recovery &
Distillation Equipment

SEND FOR CATALOGS

RESEARCH AND TESTING LABORATORY

To assist you in the solution of processing problems, BUFLOVAK offers the facilities of its Research and Testing Laboratory . . . where small scale experimental units show you before you buy, the commercial possibilities, data on production cost, and characteristics of the finished product.

Buflovak FLAKERS & COOLING DRUMS

New Features Speed Production . . . Lower Costs

A uniform, high quality, finished product . . . more of it . . . and at lower cost! That's the operating experience of many industries where BUFLOVAK Continuous Flakers and Cooling Drums are used. There are many new features that give new profit-building results. Large units for flaking products of low melting point have drums equipped with spray nozzles located on the inside of the drum to provide uniform cooling. For small flakers and products of high melting point, the cooling drum is provided with a special internal baffle that insures uniform cooling and exceptionally high heat transfer. The cooling mediums may include water, brine, or direct expansion.

BUFLOVAK Flakers can be equipped with a wetting roll that deposits a thin film of moisture on the surface of the drum before it dips into the hot material. This arrangement facilitates the removal of the film of product from the drum, thereby increasing production, lowering power, and greatly increasing the life of the knife.

BUFLOVAK Flakers are built in open or closed types. The latter eliminates dust and toxic hazards in handling poisonous material. They are available in several sizes of any suitable material of construction, with individual modifications to suit various applications; such as, steam jacketed, direct fired, or electrically heated feed pans.

BUFLOVAK Flakers are extensively used in the Chemical industries to produce a granular or flaked material from such products as caustic soda, phthalic anhydride, asphalt, DDT, benzine, hexachloride, pitch, naphthalene, sodium sulphide, calcium chloride, stearic acid, niter cake, many intermediates, and liquids which solidify upon cooling. This process offers continuous operation, a large capacity, and a finished product which is free from lumps.

The technical staff of BUFLOVAK can help you with your flaking and cooling problems.

You will be sure of better results from BUFLOVAK!

Send for Catalog 352

BLAW-KNOX

BLAW-KNOX COMPANY
BUFLOVAK EQUIPMENT DIVISION
1549 FILLMORE AVE.
BUFFALO 11, N. Y.

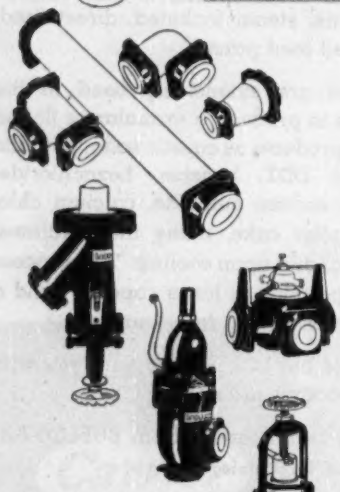
SAFEST way to handle acid corrosion

SAFE from corrosion

SAFE from contamination

SAFE for plant and personnel

Lapp CHEMICAL PORCELAIN



ANGLE AND Y-VALVES ½" TO 6"
PLUG COCKS 1", 1½", 2"
FLUSH VALVES FOR 3", 4", 5"
TANK OUTLETS
PIPE AND FITTINGS ½" TO 8"
TOWERS 12", 18", 24"
RASCHIG RINGS ⅜" TO 3"
TOWER PLATES

For problems involving severe corrosion, or elimination of contamination, best bet is a material chemically inert to product being handled—and it should be hard, smooth, strong, and non-porous.

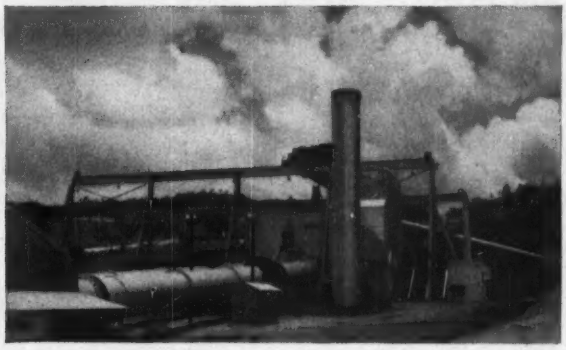
That's a description of Lapp Chemical Porcelain—and a list of characteristics which have won it a permanent place in hundreds of plants, and hundreds of processes, where no other material ever gave as satisfactory service.

The bonus is that it costs a lot less initially than most corrosion-resistant alloys and lined equipment. And the economy is increased in the fact that it almost never needs maintenance or replacement.

We want to make special mention of the item "safe for plant and personnel." Lapp Porcelain is much tougher and stronger than most people give it credit for. However, under severe shock, physical or thermal, it will break. In the past we've supplied our equipment with several types of armor. Today, we've got the simplest, most economical, and best. We call it TUFCLAD. It consists of multiple layers of heavy fiberglass woven cloth, impregnated and bonded with an Epoxide resin. This armor shell acts as a cushion against impact damage, and insulator against thermal shock. But most important, it is of itself strong and tough—will hold line pressures even when porcelain is cracked or broken.

For your problem of corrosion or contamination, Lapp Chemical Porcelain may bring you a new standard of untroubled service, improved quality and lowered cost. Write for description and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 155 Wendell St., Le Roy, N. Y.

a world of experience
AT YOUR COMMAND



Traylor's half-century of engineering experience is at your command for more profitable production of many types of products such as: **Lime • Cement • Roofing Granules • Bauxite • Magnesia • Dolomite • Phosphate Rock • Vermiculite • Diatomacious Earth • Lime Sludge • Sodium Silicate • Titanium • Sodium Chromate • Zinc Oxide • Iron Sulphide • Nickle • Aluminum Sulphate • Gold • Silver • Petroleum Coke • Manganese • Iron Ore • Potassium Salts • Expanded Aggregates • Mercury • Alumina • Lithopone**

Traylor Rotary Kilns are working around the clock and around the world . . . in the production of Copper in far-off Chile . . . Paper products in Palatka . . . Lime in Louisiana . . . and Bauxite in the British West Indies. At home and abroad Traylor Equipment is daily meeting the most exacting requirements of rugged production schedules.

Chances are that we have in the past "Traylor-Made" a Rotary Kiln very similar to the one you need for more efficient thermo-processing of your particular product. Use the world-wide experience of Traylor engineers to be sure of peak production profits. Have a kiln "Traylor-Made" especially for your needs.

Traylor
ROTARY KILNS

TRAYLOR ENGINEERING & MANUFACTURING CO.
1511 MILL ST., ALLENTOWN, PA.

Send me your free illustrated Bulletin 115 outlining the features of Traylor Rotary Kilns, Coolers and Dryers.

Name: _____

Title: _____

Company: _____

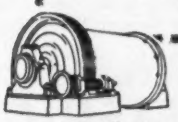
Address: _____ *State:* _____

Sales Offices: New York • Chicago • San Francisco
Canadian Mfrs: Canadian Vickers, Ltd., Montreal, P.Q.

Primary Gyratory Crushers

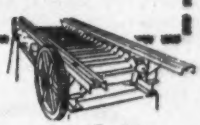
Rotary Kilns

Secondary Gyratory Crushers

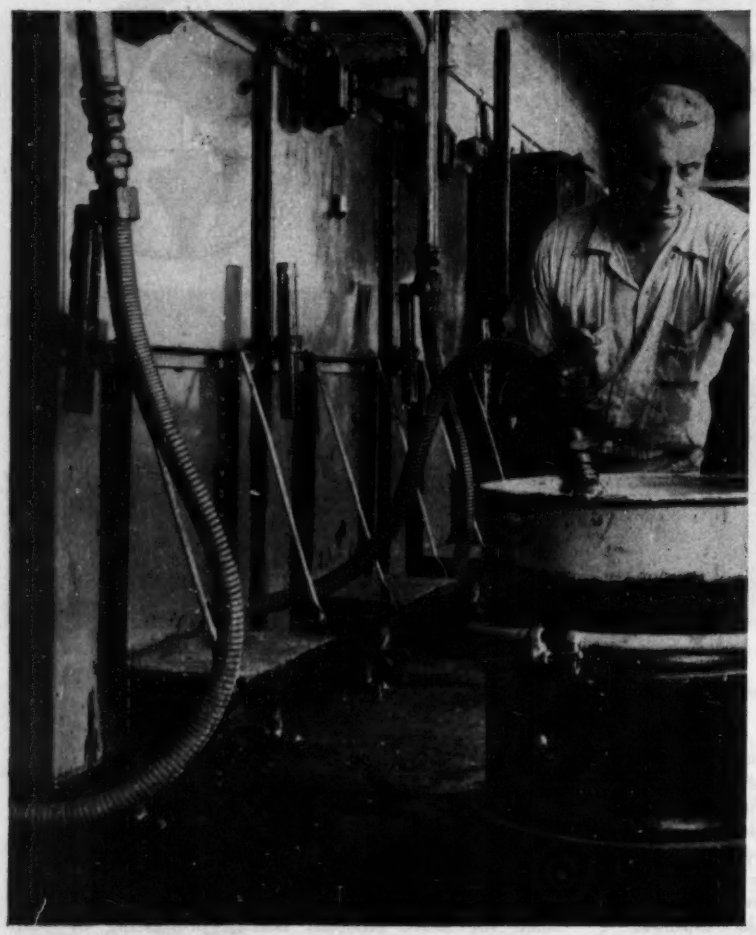


Ball Mills

Jaw Crushers

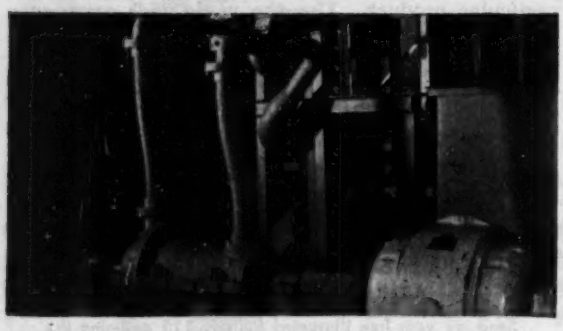


Apron Feeders

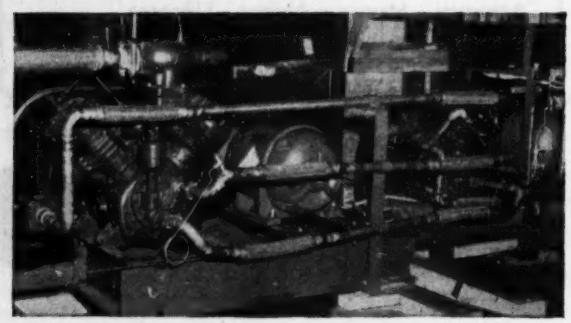


News about flexible metal hose and tubing

HERE IT SAFELY CONVEYS PRINTING INK. To get acetate base color printing ink from barrels to mixing tanks, the New York News uses six 8½ ft. lengths of American Flexible Steel Hose. Each bends to the position shown about 5 times a day. The News reports, "They're as easy to handle as original fabric covered hose . . . show far superior service life." If you need a connector that must move, bend or convey steam, oil, liquids, gases or semisolids, American can supply one of the right alloy. 53216



HERE IT ADJUSTS READILY AND CONVEYS SULPHITE PULP. This high-speed refiner adjusts to different degrees of action. A sliding shell does the trick. This calls for a hose that will allow for this movement and also compensate for fixed-position misalignment. E. D. Jones & Sons Co., the manufacturer, found two 3 ft. lengths of American Flexible Bronze Hose the answer. Like all American Flexible Metal Hose and Tubing, it installs easily . . . takes punishment.



HERE IT REDUCES VIBRATION AND CONVEYS FREON GAS. Built by Bowser Technical Refrigeration, this condensing unit for a walk-in type low temperature test chamber uses 10 American Vibration Eliminators to reduce vibration . . . prevent its transmission throughout the entire system. Made of bronze, these VE's also provide for slight expansion and contraction in the rigid piping. They are absolutely pressure-tight . . . safe for conveying costly refrigerants.

WRITE FOR BOOKLET CC-400: shows how the tubing is designed, used and installed—gives specifications on tubing and fittings. *The American Brass Company, American Metal Hose Branch, Waterbury 20, Conn. In Canada: The Canadian Fairbanks-Morse Co., Ltd.*

WHEREVER CONNECTORS MUST MOVE **AMERICAN** flexible metal hose and tubing an ANACONDA® product

P·A

GAS SCRUBBERS

• are stopping air pollution

• and recovering valuable materials

all over the country

More than five billion CFD! That's the installed capacity of P-A Venturi and Cyclonic Scrubbers now at work in twenty-six states and 9 foreign countries. These installations . . . all completed within the last four years . . . are proof of the success of Pease-Anthony methods of handling difficult gas scrubbing problems. • Bring your problem to Chemico. Take advantage of our experience in this field. Write to our P-A Sales Department for our specific suggestions. Ask for Bulletin M-102.

Phone (MU 8-2370) or write our P-A Sales Dept. for further information and ask for our Bulletin M-102 on P-A Gas Scrubbers.

CHEMICAL CONSTRUCTION CORPORATION

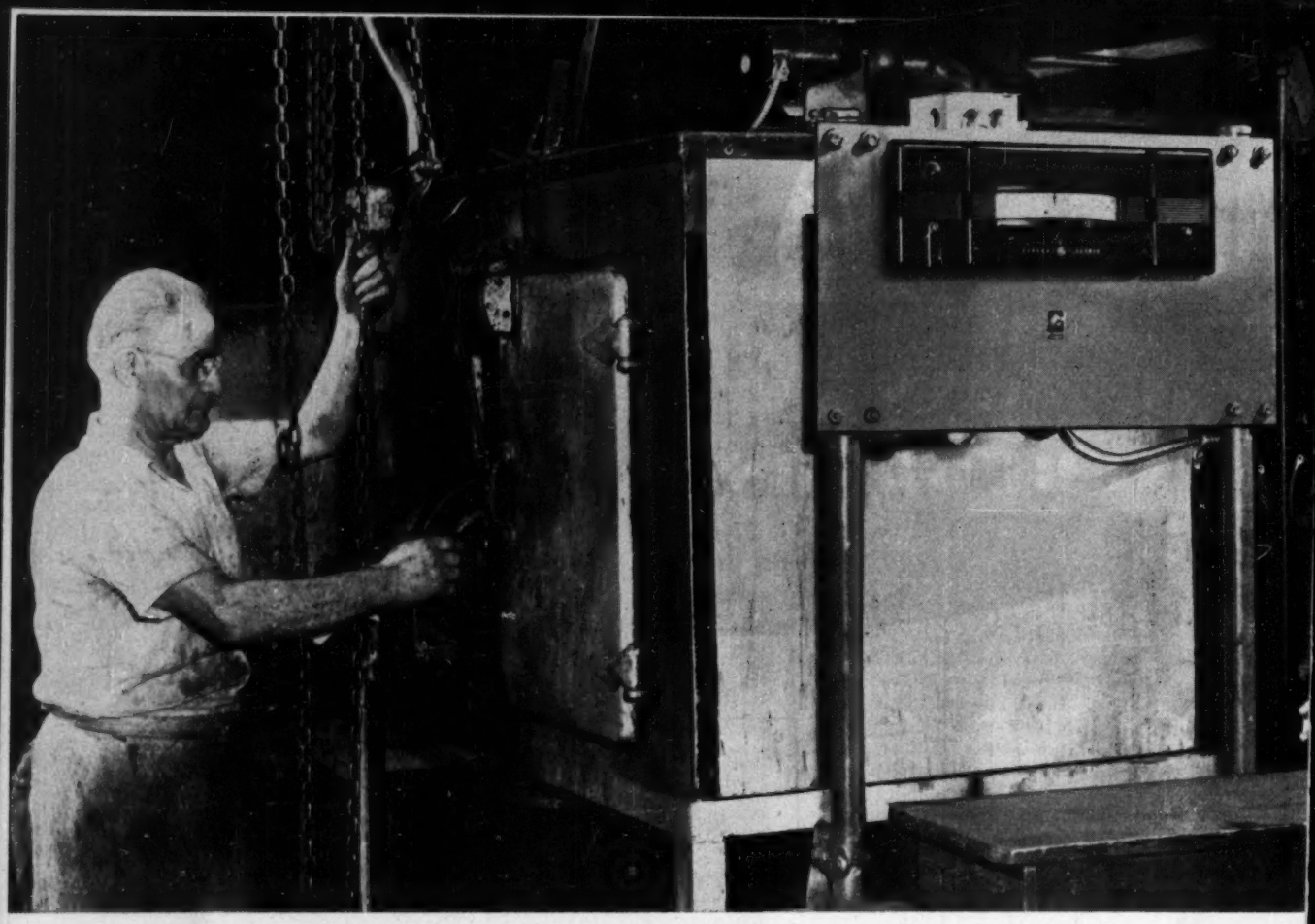
A UNIT OF AMERICAN CYANAMID COMPANY

488 MADISON AVENUE, NEW YORK 22, N. Y.

Technical Representatives Throughout the World • Cables: Chemiconst, New York

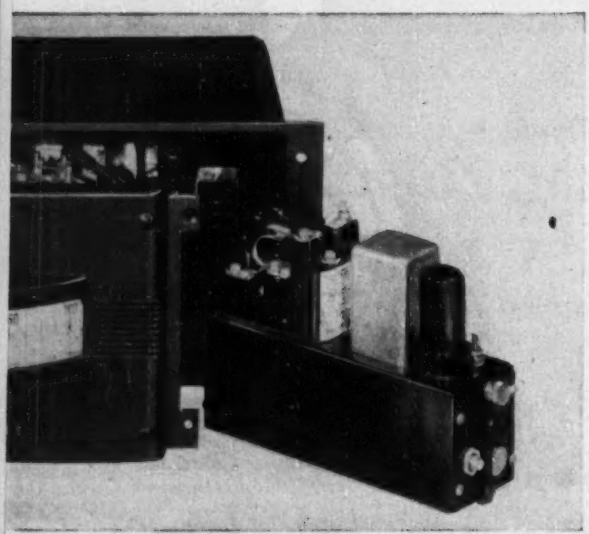
Chemico plants are profitable investments

CC-242



G-E PYROMETER-CONTROLLER ASSURES EVEN TEMPERATURES IN BAKING OF MOTOR STATORS—HELPS REDUCE REJECTS

Improve Product Quality, Reduce Rejects with G-E Precision Pyrometer-Controllers



PLUG-IN CONTROLLER UNIT pulls out easily for convenient maintenance checking. Standard vacuum tube may be replaced at low cost at any radio-tube supply store.

Excessive overheating costs you money—as production rejects increase and your product's quality drops.

General Electric pyrometer-controllers offer you a low-cost way (prices start at $215.78*) of maintaining even furnace temperatures despite changes in voltage or ambient. This precision control can help you to reduce rejects, and hold the line on product quality.

HIGH SENSITIVITY of G-E controllers means that any change in temperature equal to 2/10 of 1% of full scale is enough to initiate control action.

This line of HP controllers is accurate to 3/4 of 1% of full scale.

SEVERAL TYPES AVAILABLE, including indicators, indicator controllers, and protectors—in either 2-position or 3-position models. Scale requirements can be fulfilled from a variety of ranges in the 0-3000F span.

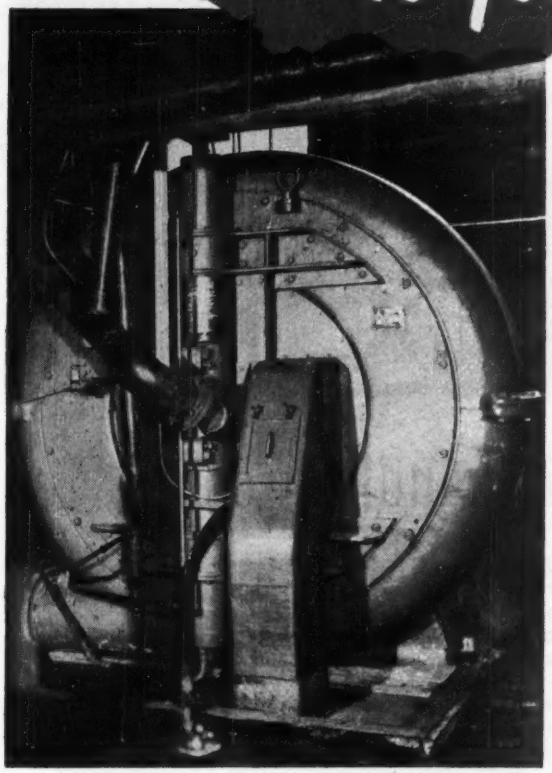
FOR COMPLETE INFORMATION, contact your G-E Apparatus Sales Office, or write for Bulletin GEC-713 to General Electric Company, Schenectady 5, N. Y. 602-264

*Manufacturer's suggested retail price.

GENERAL ELECTRIC

Which Centrifuge can provide

the best solution to your problem?



One of seven 67" Reineveld Centrifuges now operating in the world's largest potato starch factory.

This is a question that only *you* can answer . . . because you know the full details concerning your application.

But even complete knowledge of all your needs will not assure your picking the right centrifuge unless you know about ALL centrifuges that can answer your problem.

WE'D LIKE TO TELL YOU ABOUT REINEVELD CENTRIFUGES THROUGH OUR BOOKLET 4-RC-3

Review this booklet and compare centrifuges in detail . . . prices, production, square feet of filtering surface, construction, weight, maintenance or by any yardstick you choose.

Then if you don't honestly believe that Reineveld Centrifuges compare favorably with any other centrifuge of its type from any angle . . . throw the booklet away and forget about what we've said.

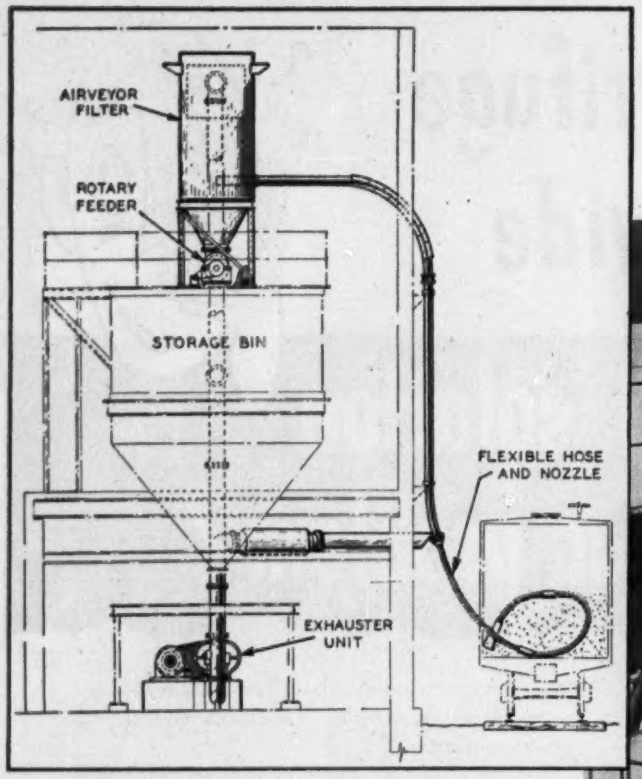
But if you agree with us that the Reineveld Centrifugal Machines offer you practical operating advantages . . . then it will pay you to call on Reineveld and Heyl & Patterson for profitable suggestions on your centrifuging problems.

Send today for your copy of Booklet 4-RC-3.

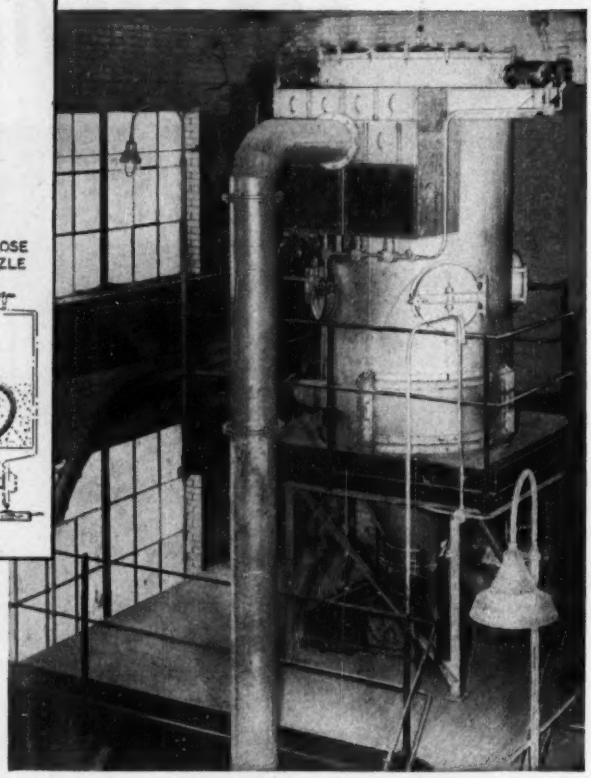
Heyl & Patterson, Inc.

"SINCE 1887"

55 FORT PITT BLVD. PITTSBURGH 22, PA.

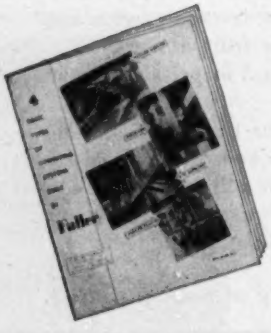


Airveyor installation for handling pebble lime in a large steel mill, unloading from cars at rate of 7½ tons an hour.



The AIRVEYOR®

keeps your handling costs down



Write for Bulletin G-1

Conveying dry, pulverized and granular materials such as lime, soda ash, flour, sugar, clays, borax, cellulose acetate, magnesium, and numerous other materials with the Airveyor offers many definite savings you cannot afford to overlook . . . lower cost of bulk over bagged materials . . . lower cost of unloading, storing, and in-plant rehandling of such materials. These advantages are yours, plus clean and dustless operation, minimum labor and convenience in reclaiming from storage for delivery to process . . . with the Airveyor.

If your problem involves bulk handling of dry pulverized and granular materials, call on Fuller's 26 years of specialized experience. You can save time and money by calling Fuller . . . get in touch with us, while your plans are in the formative stage.

FULLER COMPANY, Catasauqua, Pa.
Chicago 3—120 So. LaSalle St.
San Francisco 4—420 Chancery Bldg.

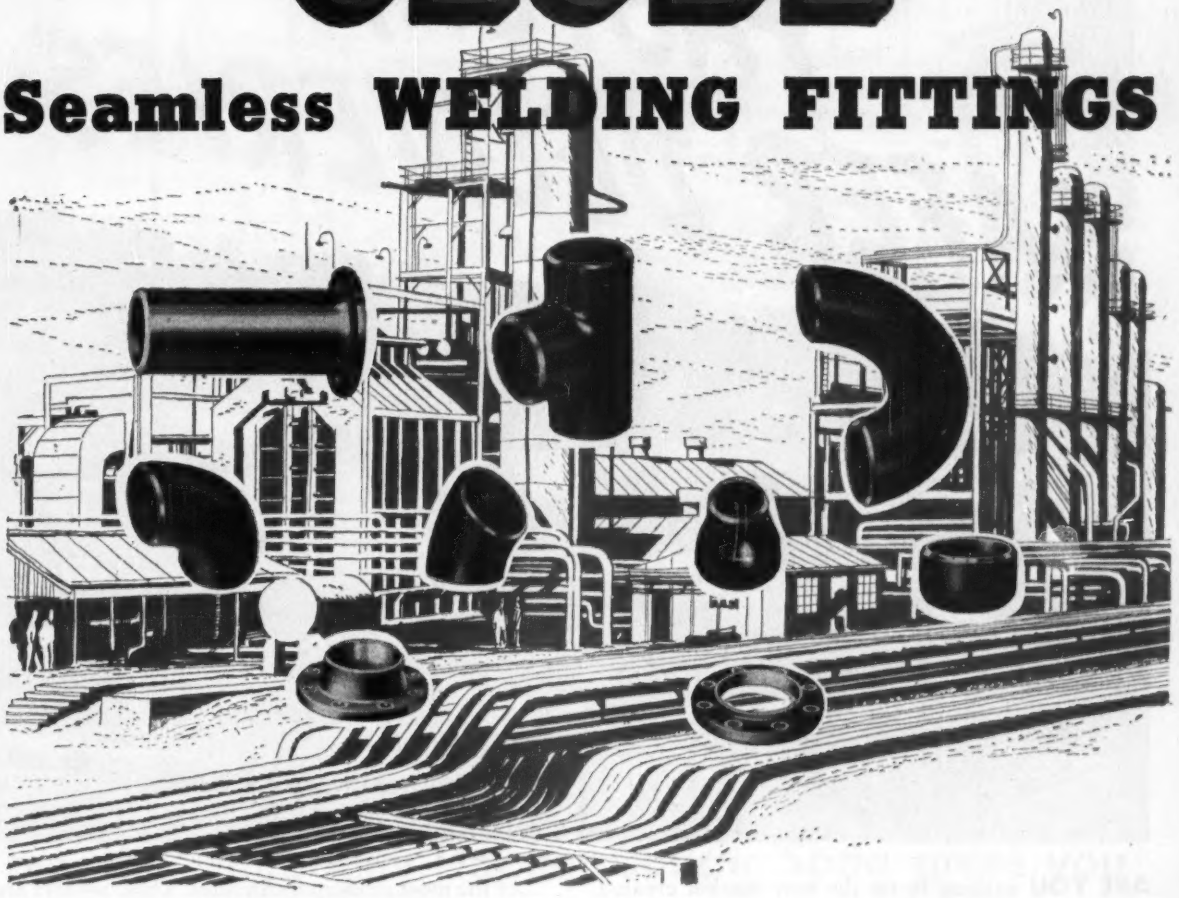
Fuller

DRY MATERIAL CONVEYING SYSTEMS AND COOLERS •
COMPRESSORS AND VACUUM PUMPS •
FEEDERS AND ASSOCIATED EQUIPMENT

A-153
1813

GLOBE

Seamless WELDING FITTINGS



The only seamless welding fittings precision-processed . . . from billet . . . to tube . . . to fitting

From charging the specially designed revolving furnace with a steel billet (above) through the many succeeding steps of production, every Globe process is specialized to produce fittings of unvarying quality.

Globe precision-process manufacture begins with the billet —continues through the making of the seamless steel tube (Globe alone among welding fittings manufacturers produces seamless steel tubes)—and extends through to the production of the finished fittings.

Because Globe has highly specialized controls—at every stage of manufacture at its own plant—you can be sure of uniform high quality seamless welding fittings when you specify Globe.

Send for the Globe Welding Fittings complete catalog.

GLOBE STEEL TUBES CO.,
Milwaukee 46, Wisconsin

Chicago • Cleveland • Detroit • New York • Philadelphia • St. Louis • Denver • Houston • San Francisco
Glendale, Cal.

Producers of Globe Welding Fittings — Globe seamless stainless steel tubes — alloy-carbon seamless steel tubes — Gloweld welded stainless steel tubes — Globeiron (high purity ingot iron) seamless tubes.

AVAILABLE IN A COMPLETE LINE OF SIZES AND WEIGHTS THROUGH GLOBE DISTRIBUTORS IN ALL KEY CITIES

LOOK TO A.C.F. FOR

FASTER, SAFER DELIVERIES

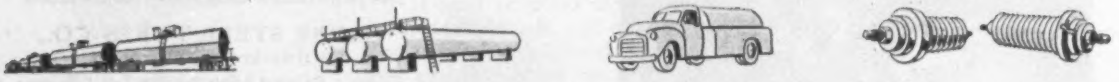
ARE YOU cashing in on the new market created by Anhydrous Ammonia, the miracle fertilizer? A.C.F. has helped to establish and expand this growing market by providing tanks, truck tanks and tank cars that make handling and distribution faster, safer and more economical.

The higher safety standards of the A.C.F. U-68 Tank are the result of x-ray inspection of every inch of welded seam...of continuous stress relief ...of the most modern techniques. Their owners are able to acquire and hold the choicest business locations in their markets. What's more they're lighter, cost less to ship...an important point to consider.

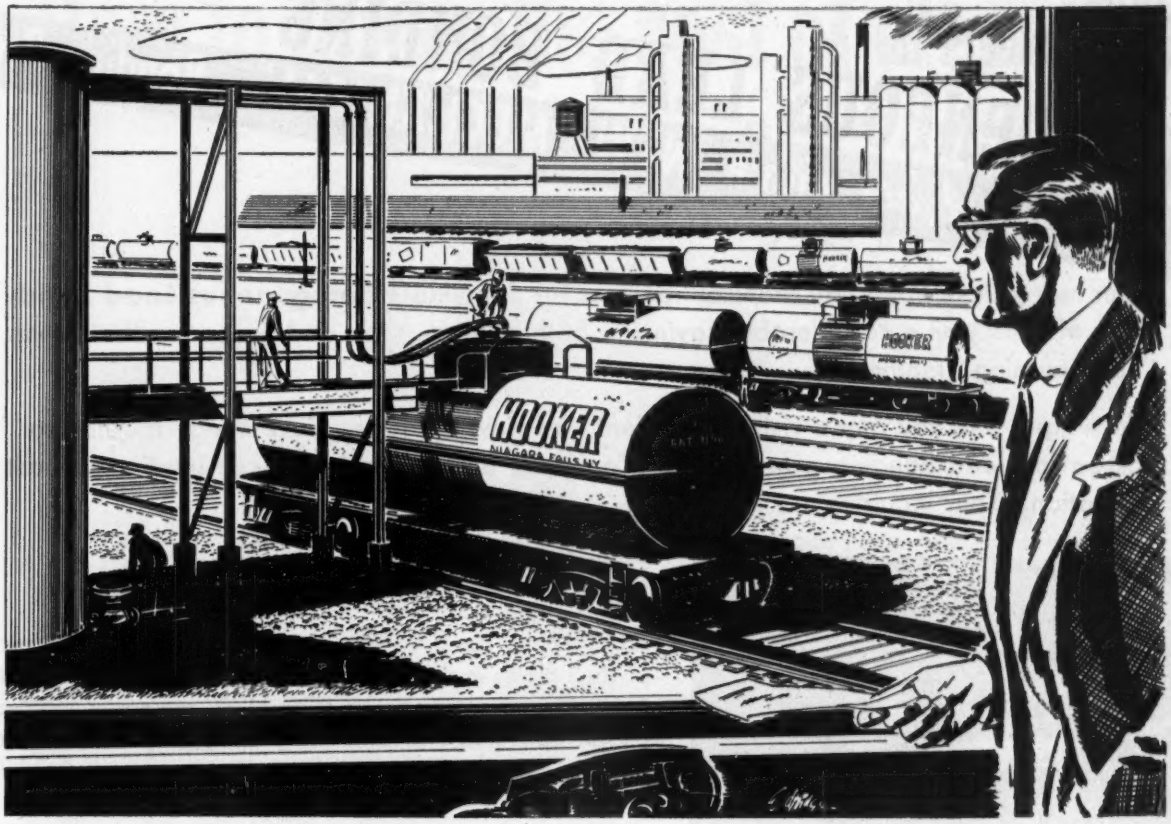
The complete facts may be the beginning of a new money-making opportunity for you. See your A.C.F. Representative today. American Car and Foundry Company, New York · Chicago · St. Louis · Cleveland · Washington · Philadelphia · San Francisco.

and the A.C.F. LINE *for*

TANK CARS • STORAGE TANKS • TRUCK TANKS • SAFETY VALVES



A.C.F. *Quality you can trust*



For smoother, better processing–

buy the Uniformity Hooker Caustic Soda gives you

Month after month, year after year—you can standardize processing methods, and get consistent results, when you use Hooker Caustic Soda.

You need never adjust your process to meet variations in caustic soda shipments. You can be sure each new shipment closely matches your current inventory.

Uniformity, from shipment to shipment, is the result of close quality checking at Hooker. More than a score of inspections and analyses safeguard the uniformity of the Hooker caustic you buy.

Do you agree, with leading companies in 30 different industries, that this is a good reason to *standardize* on Hooker caustic soda?

If you do, a letter or a phone call to the nearest Hooker plant or office will quickly bring you the product data and other facts you need to make your decision.

You can *standardize* on Hooker Caustic Soda

Forms: Liquid 50% and 73% • Flake • Solid • Special fine flakes

Containers: Tank cars • Tank wagons • Barges • Drums

For fast service, phone:

CHICAGO	CEntral 6-1311
LOS ANGELES	NEvada 6-3826
NEW YORK	MUrray Hill 2-2500
NIAGARA FALLS	6655
TACOMA	Broadway 1215

HOOKER CHEMICALS

From the Salt of the Earth

HOOKER ELECTROCHEMICAL COMPANY

HOOKER ELECTROCHEMICAL COMPANY
5 Forty-Seventh St., Niagara Falls, N. Y.

Please send ☐ data sheets on Hooker Caustic Soda; ☐ Bulletin 100 describing Hooker products and services.

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

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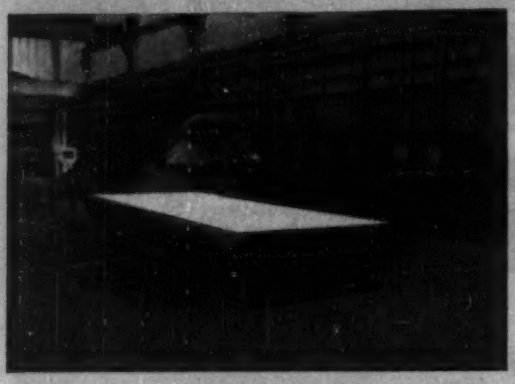
KELLEY

Pioneers in HOMOGENEOUS LEAD BONDING

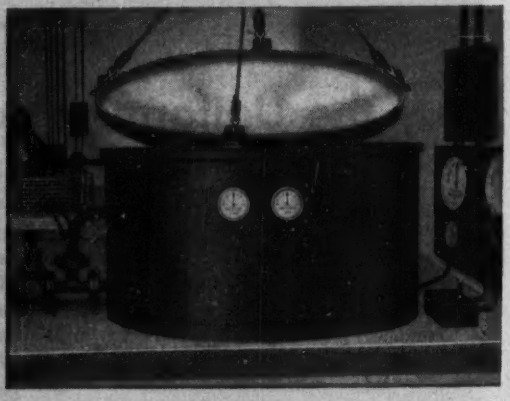
First Again with a "NEW MECHANICAL"* Bonding Process

*Our newly developed "mechanical" process for applying **Homogeneous Lead Bondings** affords you a considerable saving in both delivery time and cost over the slower "hand-burning" method.

We suggest that you pay a visit to our plant and view this newly developed "Mechanical" cost-saving lead bonding process. Our Engineers are available for consultation without obligation. Your inquiries are solicited.

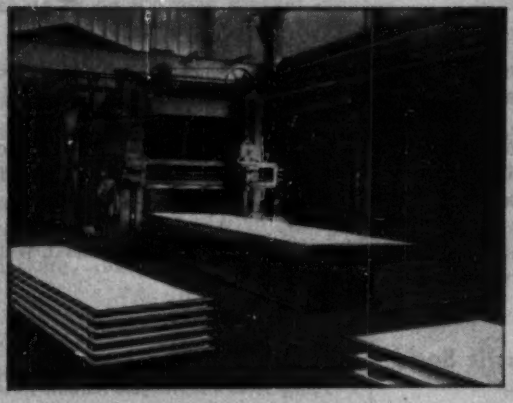


Homogeneous Lead Bondings are applied to any thickness of shell plates in the flat before shaping to your specifications. Plates as large as 10'-0" x 20'-0" are easily handled on our new unit, thus eliminating many unnecessary weld seams. Outlets and connections are Homogeneously Bonded regardless of size.



Dished Heads of all types and various irregular shaped pieces of equipment are Homogeneously Lead Bonded in our Special "MECHANICAL" Unit. Here again, considerable saving in time and cost is effected over the general method.

To insure uniform overall thickness of the Homogeneous Lead Bondings and eliminate the human errors occurring in other methods, lead is applied "oversize" to flat sheet plates and then planed to required thickness. In addition, this operation affords considerable savings in time over the general "Hand Scraping" method.



KELLEY Custom-Built for the Processing Industries

TANKS · LEAD COILS · LEAD & LEAD LINED VALVES
SHEET LEAD LININGS · CASTINGS & FITTINGS

STAINLESS STEEL
LEAD
WOOD
STEEL
Fabrication

O. G. KELLEY & CO.

ENGINEERS DESIGNERS FABRICATORS

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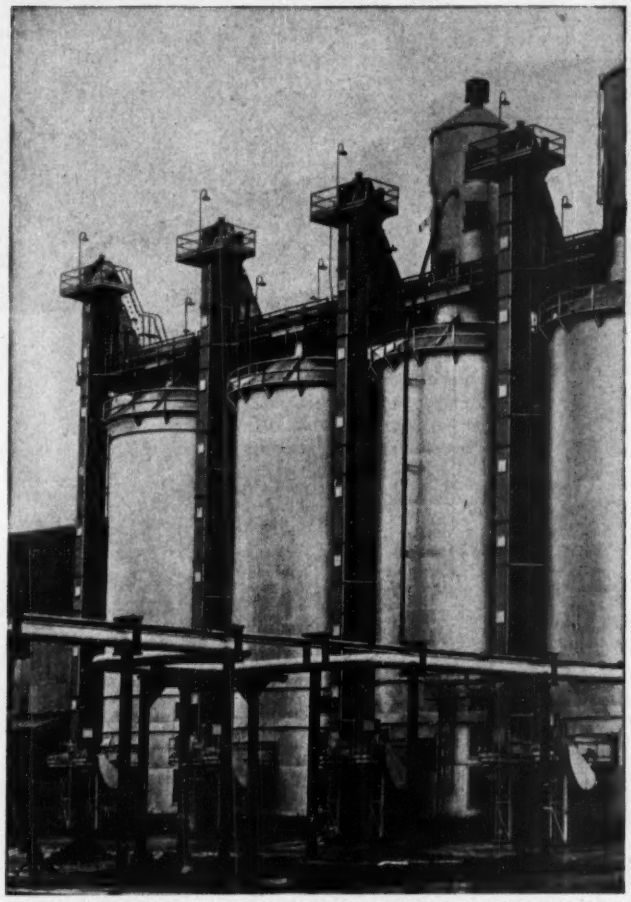
How to lower the cost of elevating



Let LINK-BELT recommend the bucket elevator that meets your requirements from 13 types in 4 basic designs

WANT to cut your cost of raising materials to processing machinery or to storage bins or silos? Regardless of the capacity required — or the characteristics of your material — there's a Link-Belt Bucket Elevator for the job.

Working with this broad line, Link-Belt engineers can select the one best-suited to your needs. A wide range of sizes on chains or belts is available.

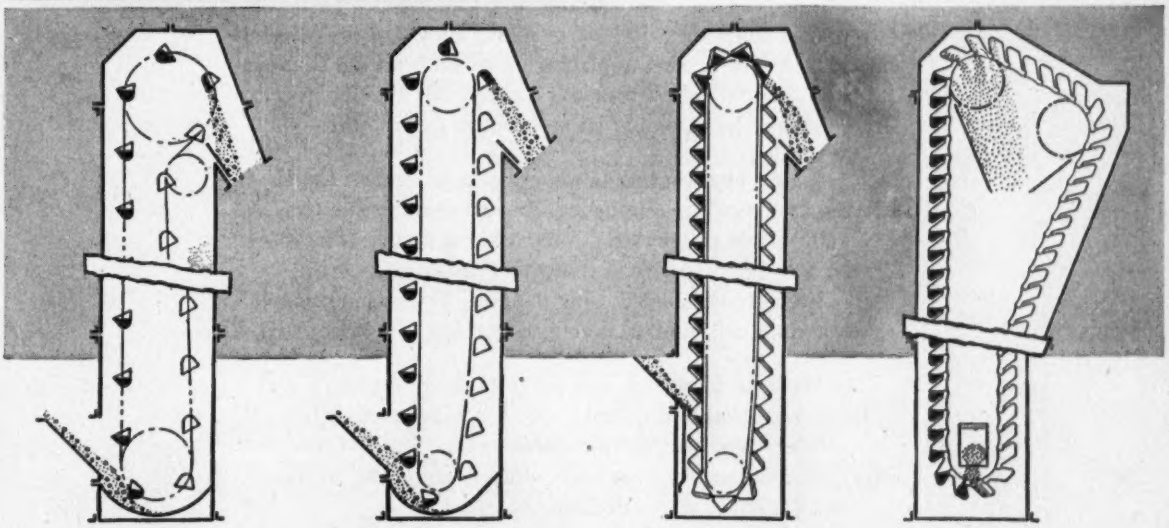
What's more, installation, maintenance and operating costs are low with Link-Belt Bucket Elevators. Rigid, jig-built casings are self-supporting, need only occasional lateral tie-ins depending on height. You have quick access to both head and boot for periodic inspections. Simple screw or gravity take-ups maintain chain or belt tension at all times.

There's an experienced materials handling engineer in the Link-Belt office near you. Call him for complete information.

LINK-BELT

BUCKET ELEVATORS

◀ Four Link-Belt centrifugal discharge bucket elevators, each with 30 TPH capacity, handling cellulose acetate at a large chemical plant.



Positive discharge for light, fluffy, fragile or materials that tend to stick to the buckets.

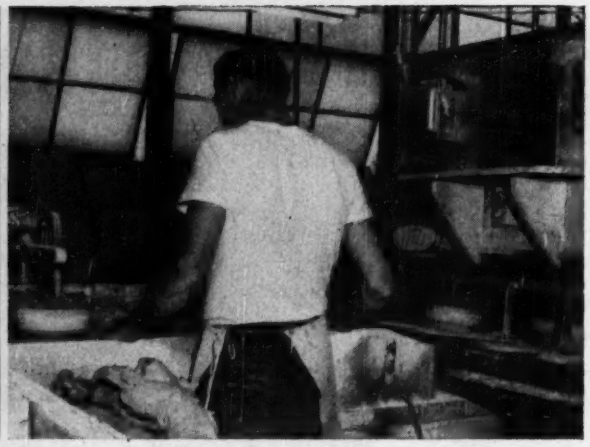
Centrifugal discharge for free-flowing, fine or loose materials with small to medium lumps.

Continuous discharge for range of materials —light to heavy, small to large, abrasive lumps.

Internal discharge for gentle handling of small articles such as pellets, seeds, castings.

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13,286-B

Electromax for plating-tank control at Barnes Manufacturing Co. (plumbing fixtures) saves its cost in 6 months in reduced maintenance. Electromax resists humidity & acid mist.



The Sterling China Co. says "Our two Electromaxes do a perfect job at no expense; no maintenance; no attention from supervisors". Electromax resists dust & vibration.

No-maintenance Controller?

WELL, ALMOST . . .

● For years at a time, your instrument maintenance men may never even see the inside of your Electromax Temperature Controllers.

And when they do look into one, they find only five items that could ever need replacing—two 120-volt light bulbs, two ordinary radio tubes and a relay. All five of these expendable elements could be replaced in five minutes.

Fine engineering, however, greatly reduces the chance of even that much maintenance. Design requires the two radio tubes to operate at only 10% of rating. The relay (the only moving part in the whole instrument) is a hermetically-sealed, plug-in type. There's no dry cell, no standard cell, no ink, no chart, nothing to lubricate.

With its small size, low price, excellent accuracy and really remarkable simplicity, you'll find many uses for Electromax, at temperatures to 1000 F. You can get full information from the L&N office nearest you, or from 4916 Stenton Ave., Philadelphia 44, Pa.

LEEDS & NORTHRUP
instruments · automatic controls · furnaces

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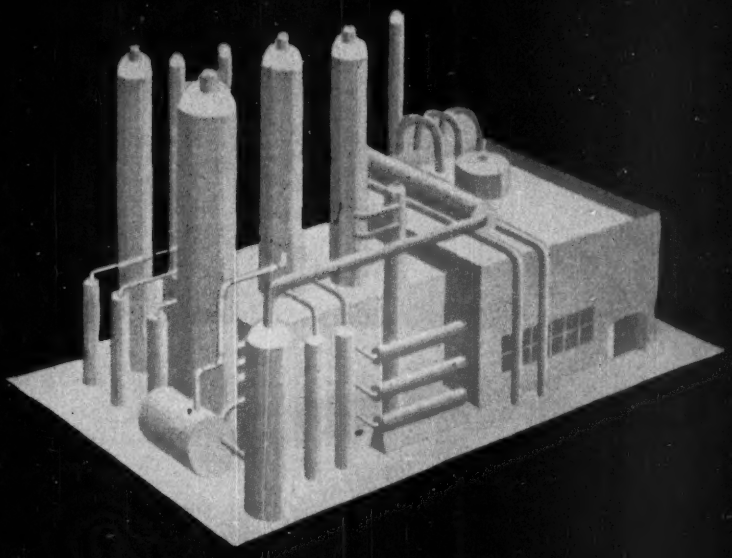
AUTOMATION...



will prevent processing headaches

The increasing complexity of petrochemical processing will call for automation beyond today's approach to measurement and control.

Continuous analyzers, for example, point to a significant trend toward "thinking machines," which may ultimately control a whole process on the basis of desired qualities in the finished product. Honeywell has helped to implement this and other new concepts, and will continue to work toward the realization of practical automation.

While the capabilities of instrumentation are being extended, so too is its dependability. For the more automatic a plant gets, the greater becomes the responsibility on the automatic equipment which keeps processes coordinated.

Long identified with instrumentation's parade of progress, Honeywell's Industrial Division serves the petrochemical industry from lab to pilot plant to "on-stream" operation. MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA**: Write for your copy of "How Automatic Can We Get"—a challenging discussion of the future of instrumentation.

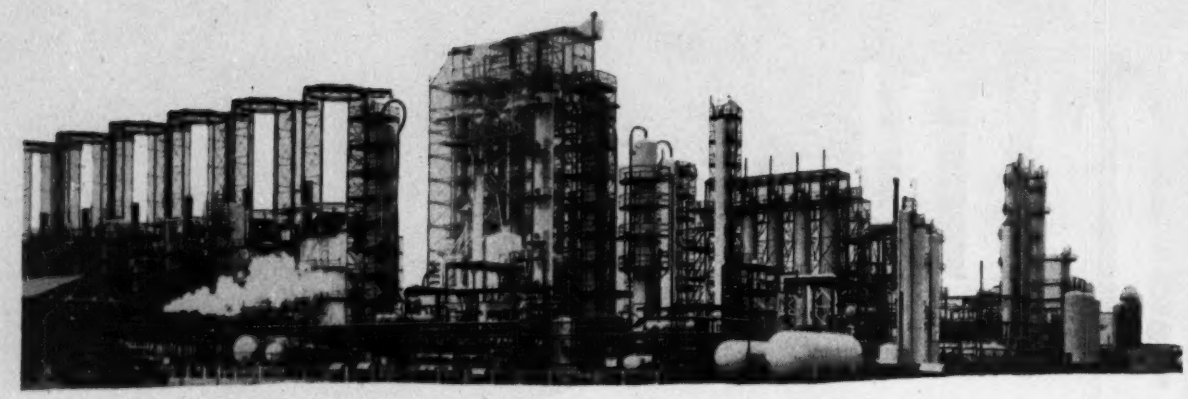
MINNEAPOLIS

Honeywell

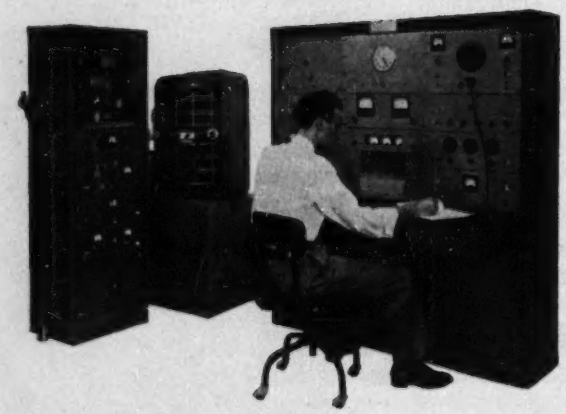
BROWN INSTRUMENTS

First in Controls

Problem: Scheduling a 38,383,000 barrel refinery program one full year in advance



Solution: A Consolidated Model 21-103 Analytical Mass Spectrometer



Richfield Oil Corporation's huge, fully-integrated California refinery processes an average of 105,000 barrels of crude oil daily into a complete petroleum product line. Using a single CEC Analytical Mass Spectrometer one operator completed 6,787 analyses in 1952 on a single-shift basis. Management now plans to double this outstanding performance by running two shifts. The amazing accuracy, speed and reliability of this single instrument enables management (1) to catalog the exact composition of each and every process stream in the refinery; (2) maintain a refinery-wide sample analysis program; (3) assemble information to establish master production programs for each ensuing year. A 1% error in the analysis of a small portion of a refinery's process-streams can cost far more in lost product value in a single year than the cost of a Consolidated Mass Spectrometer completely installed.

Consolidated Engineering

CORPORATION

300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.,** *a subsidiary with offices in: Pasadena, New York, Chicago, Washington, D. C., Philadelphia, Dallas.*

analytical instruments for science and industry

Analytical Mass Spectrometer

The Consolidated Analytical Mass Spectrometer shown above is used extensively by leading refineries throughout the world for analytical research as well as process control. For complete information on this instrument, write for Bulletin CEC-1800B-X13.

Fractions
SOLVE BIG PROBLEMS

The petroleum industry has made good use of the "divide-and-rule" formula that conquered kingdoms . . . to win command of the giant powers hidden in nature's oil. The industry's process engineers have transformed American life by their mastery of petroleum's secrets . . . and fractionating has been their master key.

These engineers' ability to develop processes which break petroleum into its component fractions has harnessed the "black gold" into a myriad forms of service. There have been other important results, too. The gigantic motor industry . . . America's vast network of modern highways . . . the services to motor travel—these are largely by-products of the petroleum process engineer's knowledge of fractional distillation.

For many years, Sun Ship has been adding to its own prestige by the service and cooperation its great shops give to the petroleum industry, and to the many other industries which call on Sun Ship's versatile engineering and construction skills. It has built . . . for chemical and petroleum process engineers, and for refineries throughout the world . . . the immense fractionating towers, pressure vessels, special machinery and heavy equipment they require. The 95′7″ crude tower shown in the photograph, ready for shipment, is a representative example.

Sun Ship's services will continue to keep pace with the giant strides made by the nation's industries in the engineering progress which is steadily building a greater America.

Sun

SHIPBUILDING & DRY DOCK COMPANY

ON THE DELAWARE — SINCE 1916 — CHESTER, PA.

25 BROADWAY • NEW YORK CITY

Rigid testing of *Explosion-Proof* CONDULETS*

assures safety and long dependable service

Crouse-Hinds extensive laboratories and modern manufacturing combine to give you top quality

Laboratory testing is one of the key operations in the production of electrical equipment of the highest quality. Crouse-Hinds laboratories are equipped with the latest scientific instruments and staffed with expert technicians.

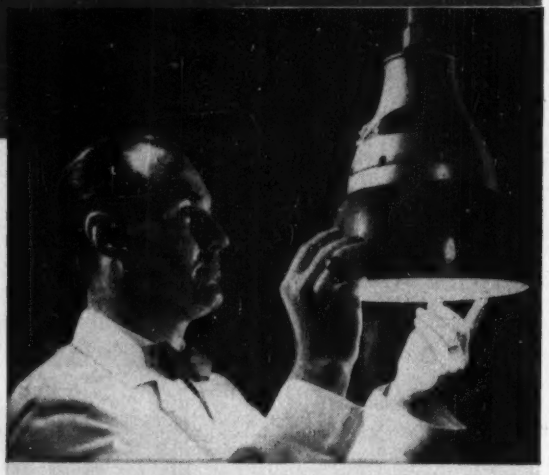
Products are constantly tested to make sure that they are being made to withstand field conditions. New devices are tested to predetermine their meeting or surpassing the requirements of Underwriters' Laboratories.

The photographs at the right show three of the many testing operations that are done in the Electrical Laboratory. It is equipped with apparatus for making both alternating and direct current tests, heat tests, pressure tests and many others.

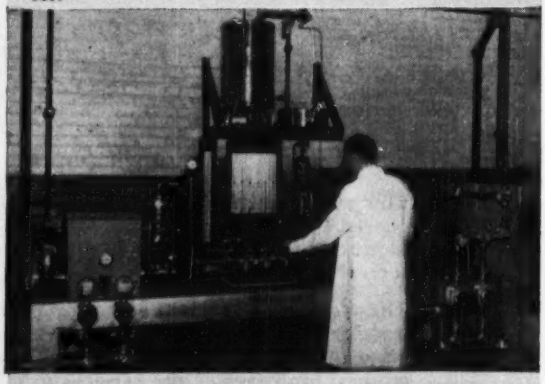
Close cooperation between Crouse-Hinds laboratories and manufacturing departments is one of the reasons why Condulets have been the "Standard of Quality" for nearly fifty years.

Specify CONDULETS on every job. They're made right... to serve you better... and last longer.

When quality counts
... you can count on Condulets



Probing for maximum exterior operating temperature on a Type EVA Explosion-Proof Lighting Fixture using a multiple point recording potentiometer.



Adjusting carburetors and flow meters to create a predetermined explosive mixture within an explosion-proof Condulet for an explosion test.

Photographing the pressure wave in the Oscilloscope to determine the maximum explosion pressure within an explosion-proof Condulet that is behind the concrete wall.

CROUSE-HINDS COMPANY
Syracuse 1, N. Y.

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Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

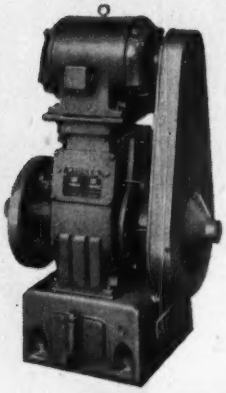
CONDULET
First in the field
STANDARD OF QUALITY

*CONDULETS are made only by CROUSE-HINDS

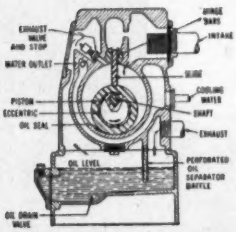
A Nationwide Distribution Through Electrical Distributors

CONDULETS · TRAFFIC SIGNALS · AIRPORT LIGHTING · FLOODLIGHTS

Cut Costs...Boost Efficiency...with Stokes High Vacuum Pumps

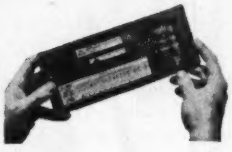


At left is the new Model G Stokes High Vacuum Pump. Basically, and in outward appearance, the new model is the same simple, efficient, compact and reliable unit as its widely used predecessor, Model F. Five major engineering improvements are incorporated in the new model: 1) a new mechanical face-seal minimizes routine maintenance and reduces to a minimum the possibility of oil leakage at the shaft; 2) new exhaust valve-stops permit use of these pumps in an exceptionally broad range of applications, including rapid cycling evacuation of large-volume systems; 3) a new intake screen filter prevents damage by dirt, scale, and other solids sometimes present in the system; 4) a new oil filter in the line to the shaft seal affords special protection to the bearings at these points; 5) a new solenoid valve in the oil supply line automatically prevents oil-flooding of the pump in the event of power failure.



The operating principles of the Stokes High Vacuum Pump are simple. Rotation of the Stokes Pump is indicated in cross-section view at left: Air enters the increasing space at right of piston, while air trapped in the decreasing space at left of piston is compressed. As piston nears top of stroke, pressure of the trapped air opens the feather-type discharge valve against atmospheric pressure, and the air is forced out of the cylinder. As piston passes through its top position, the suction port is momentarily closed by piston. Air then present in cylinder is trapped, a new cycle begins.

A completely revised brochure on Stokes High Vacuum Pumps is now available, free, upon request. It explains, and shows, how Stokes Pumps combine simplicity of design, high volumetric efficiency and lowest operating costs to provide reliable, continuous service for all kinds of high vacuum processing equipment. Examples of typical vacuum systems using Stokes Pumps are cited and typical problems in pump selection and their solution are provided. Also described is the complete line of Stokes High Vacuum Processing Equipment and the new Stokes Experimental and Applications Laboratory in Philadelphia, Penna.



The new Stokes Vacuum Calculator for rapid slide-rule calculations, including a standard ABCD log scale, is now available, free, upon request. It has proved to be of tremendous value to those engaged in vacuum research and processing, seeking to determine the proper pump to be installed for a specific process. This easy-to-use slide-rule simplifies the job of figuring the needed pump capacity to evacuate a given volume to a specified vacuum in a given time, and the time required to evacuate a given volume to a specified vacuum with the user's present vacuum pump. Vapor pressure of water at various temperatures is given, together with the boiling-points of solvents under vacuum and the capacity of round tanks in both cubic feet and gallons per foot of depth. Another table shows vapor pressures at various temperatures for use in vacuum metallurgy.

Simplicity and sturdy construction, accessibility, high volumetric efficiency, low power consumption, and effective cooling are distinctive features of Stokes High Vacuum Pumps.

Better blank-off pressures and quieter operation are assured with a completely new, longer lasting exhaust valve assembly. Intake ports are open during the entire intake cycle; there is no slide-valve shut-off.

Lubrication is completely automatic. There are no oil shut-off valves and adjustments. Horizontal vacuum intake permits trapping of harmful dirt and scale. Vacuum-tight rotary seals eliminate the need for shaft packing and constant adjustment. Easy access is provided to the valve assembly and other parts requiring periodic examination.

Stokes High Vacuum Pumps are available in capacities from 15 to 500 cfm. Where necessary, oil purification units — to assure continuous supply of clean, water-free oil — can also be furnished.

Wherever hard, continuous service is required to meet today's exacting high vacuum requirements, Stokes High Vacuum Pumps prove a profitable investment.

Consult with Stokes on the application of vacuum to drying, freeze-drying, impregnation, extraction, solvent recovery, evaporation, vacuum metallizing, and to other purposes for which vacuum deserves exploration.

F. J. STOKES MACHINE COMPANY
PHILADELPHIA 20, PA.

STOKES

STOKES MAKES: High Vacuum Equipment, Vacuum Pumps and Gages/Industrial Tabletting, Powder Metal and Plastics Molding Presses/Pharmaceutical Equipment

Constant control of quality

Quality control is a continuous job. It is carried out with modern equipment and painstaking attention to detail in every phase of the production of Nialk chemicals.

for example...

NIALK CAUSTIC POTASH: The controlled quality and uniformity of NIALK Caustic Potash and NIALK Carbonate of Potash contribute importantly to the satisfactory performance of many highly sensitive photographic baths.

Every step in the production of these NIALK products is rigidly controlled to give absolute satisfaction in many types of applications.

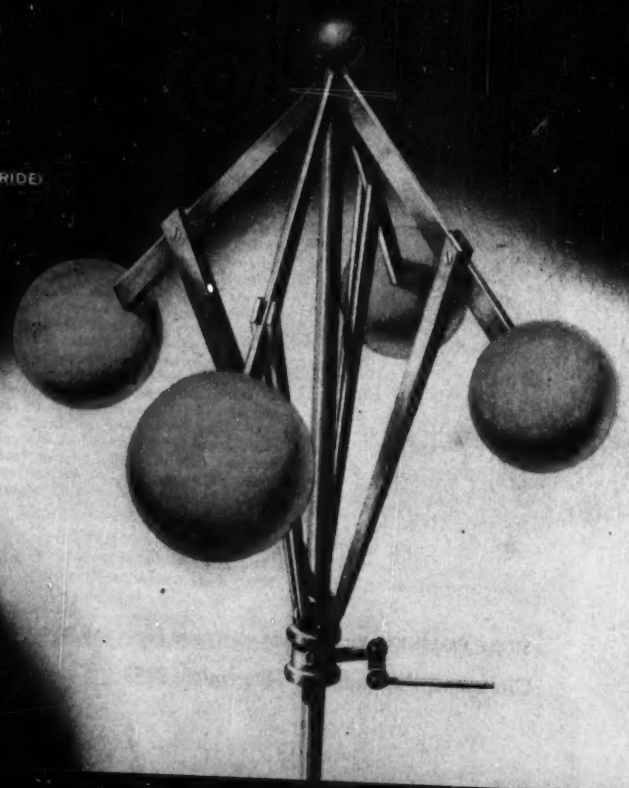
NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, New York

Nialk®

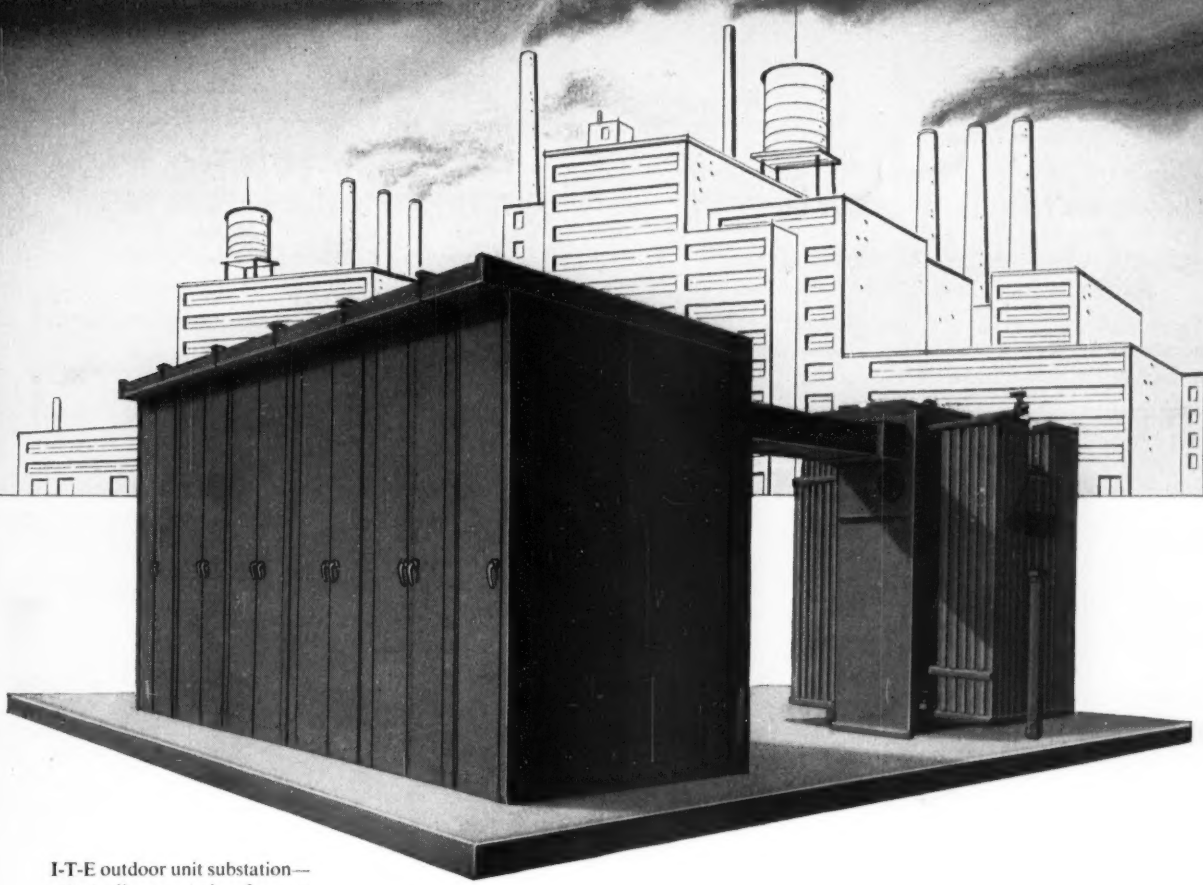
- LIQUID CHLORINE
- CAUSTIC POTASH
- CARBONATE OF POTASH
- PARADICHLOROBENZENE
- CAUSTIC SODA
- TRICHLORethylene

NIAGATHAL (TETRACHLORO PHTHALIC ANHYDRIDE)



Planned Power Distribution

—first step toward increased plant efficiency



I-T-E outdoor unit substation—outstanding example of power equipment planned for efficiency. This substation, a durable, weatherproof unit of transformer and switchgear, can be located close to load center—yet out-of-doors, where it will not take up premium production space inside the plant.

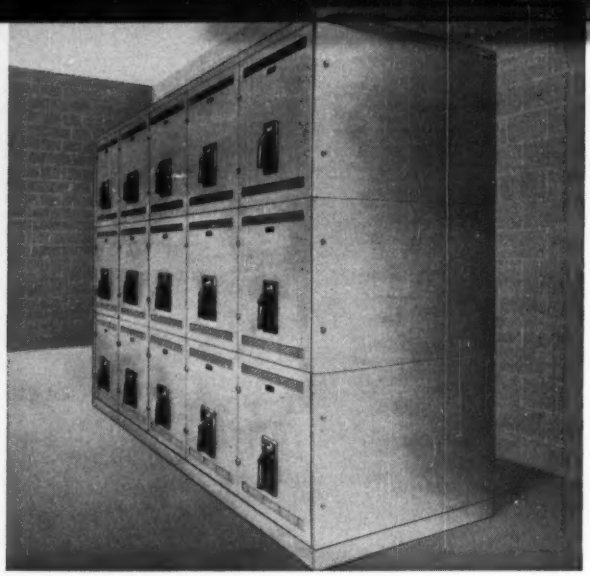
Power is fundamental. The most modern plant, the latest-type production lines can be only as efficient as the electrical distribution system that feeds them.

Plan ahead now, and avoid "patchwork" later. An I-T-E application engineer will gladly advise you how to get more efficiency from your power devices, how to lower distribution costs, and get positive electrical protection for your plant.

I-T-E METAL-CLAD SWITCHGEAR

4160 volts — 600, 1200, 2000 amperes
50,000, 150,000, 250,000 KVA interrupting

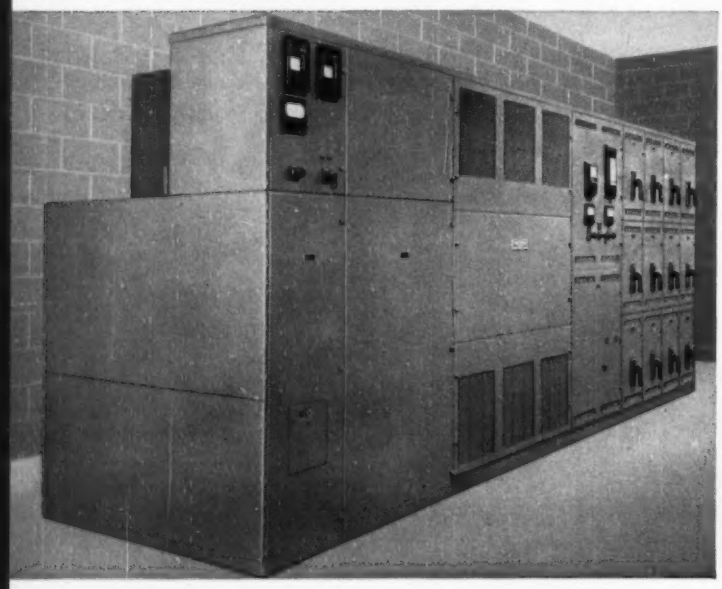
For protection of main incoming lines and feeders. Modern horizontal drawout construction guarantees savings in inspection and maintenance.



600-VOLT DISTRIBUTION SWITCHGEAR

600 volts — 6,000 amperes and below
15,000 to 100,000 amperes interrupting

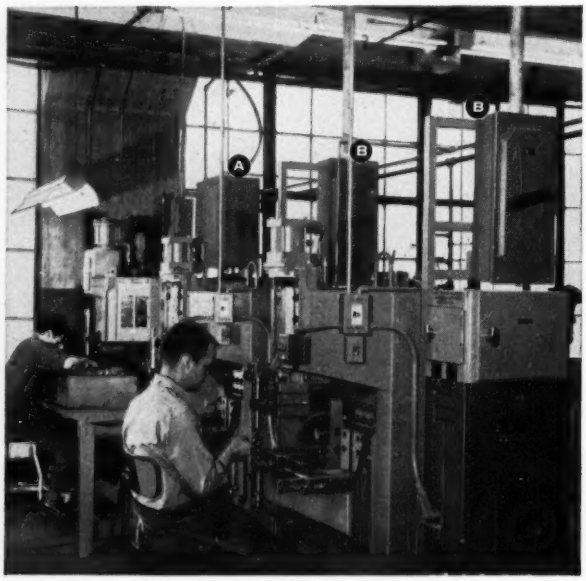
For protection of low-voltage incoming lines and feeders.



UNIT SUBSTATIONS

300 KVA and above—Primary voltage 480 and above

Coordinated Metal-clad and 600-volt switchgear, plus transformer. Substations reduce distribution losses by stepping down voltage near point of utilization.



INDIVIDUALLY-ENCLOSED CIRCUIT BREAKERS

120-600 volts 10-6,000 amperes
5,000-100,000 amperes interrupting

A complete line of large air (**A**), and molded case (**B**) circuit breakers for protection of single circuits to almost any type of plant equipment.

From power line to production line

. . . I-T-E BOOSTS PLANT EFFICIENCY

From the main plant switchboard to the smallest circuit breaker, I-T-E equipment boosts plant efficiency. Equipment is designed to facilitate efficient power distribution, to guard against overloads and short circuits, and to allow for quick restoration of service in the event of sudden power interruption.

Your plant structure and costly capital equipment are fully protected against electrical hazards at all times. Loads are fed and maintained at proper, efficient voltage. Production lines are kept on the go.

In line with latest thinking, equipment is compact, self-contained—can be located either *indoors* or *outdoors*, according to requirements. Rugged, durable enclosures are available to satisfy every plant need.

Modern design complements modern engineering. Standardized units facilitate expansion. Circuit breakers are easy to get at; maintenance is simple. Breakers can be quickly adjusted to compensate for load changes.

And throughout—safety is the keynote

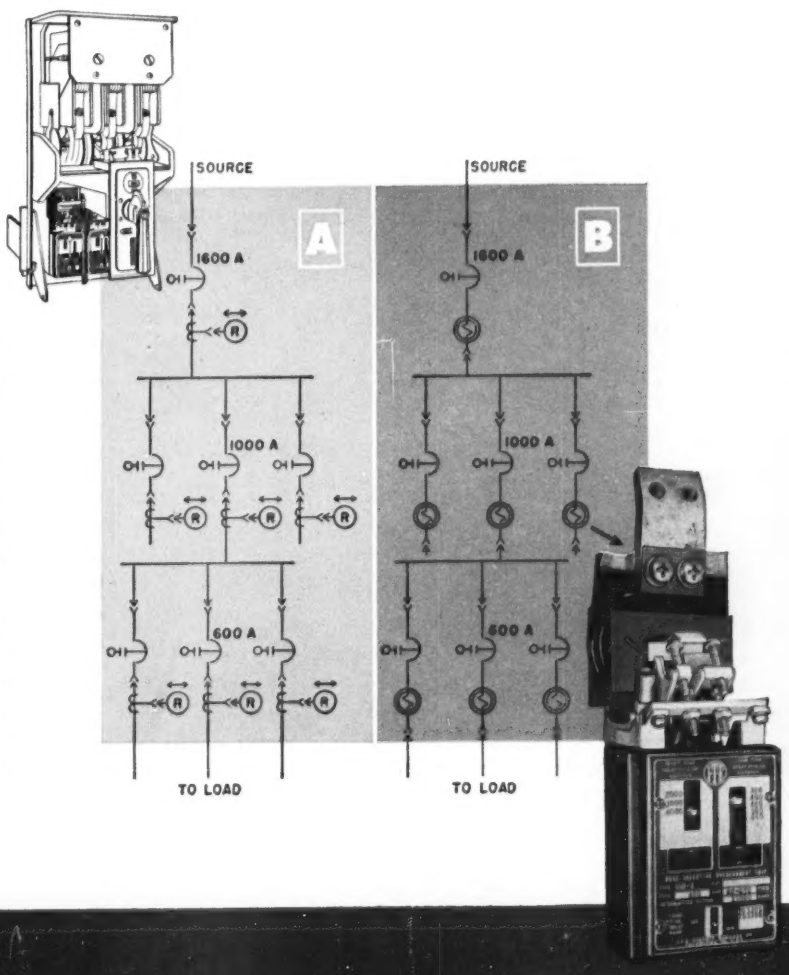
For the *utmost* in service continuity . . . I-T-E *Selective Tripping*

For those 600-volt switchgear applications in which absolute continuity of service is essential, I-T-E offers an advanced selective-trip device which mounts as an *integral* part of the circuit breaker.

By allowing the circuit breaker closest to a fault to open *first*, while other breakers remain closed, the selective-trip device *localizes* trouble. Thus, batch processes and other critical loads are insured against costly and unnecessary shutdown.

Through use of simple, compact I-T-E selective-trip devices, plants can realize an initial cost saving as high as *60%*!

Although Systems A and B (right) provide the same high degree of selective-trip protection, System B actually costs far less to install. I-T-E Direct-Acting Dual-Selective Overcurrent Trip Devices eliminate separate relays, save space, and reduce maintenance.



I-T-E CIRCUIT BREAKER COMPANY

and if DIRECT CURRENT is in the picture...

THE I-T-E MECHANICAL RECTIFIER GIVES YOU HIGHEST EFFICIENCY:

96%—and higher—from a-c line to d-c bus!

THE SAME INCOMING POWER —BUT 10% MORE CHLORINE!

Fields Point Manufacturing Corp., Providence, R. I., credits two I-T-E Mechanical Rectifiers for this substantial boost in production. Here is an excellent source of savings on power costs.

To obtain the highest rectification efficiency possible, I-T-E engineers have:

(1) taken the most efficient method for converting ac to dc—by mechanical switching; and then

(2) designed *equipment* to provide the highest efficiency obtainable with this method.

The result: almost ideal rectification!

A compact unit, easy to install and operate, the I-T-E Mechanical Rectifier gives top efficiency over the low 50 to 400 v. range—and from 25% to 125% of rated load.

The Rectifier is being used to advantage on continuous heavy-current d-c applications—in chlorine manufacturing, metal refining, and on motor load. *Thirty-seven* installed units—more than 200,000 amperes of connected load—prove the point!

FROM COAST TO COAST— STRATEGICALLY LOCATED I-T-E SALES OFFICES STAND READY TO SERVE YOU:

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Buffalo, N.Y.
Butte, Mont.
Charleston, W. Va.
Charlotte, N.C.
Chicago, Ill.
Cincinnati, O.
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St. Louis, Mo.
Salt Lake City, Utah
Seattle, Wash.
Tucson, Ariz.
Washington, D. C.
Wilkes-Barre, Pa.

I-T-E CIRCUIT BREAKER CO.

19th and HAMILTON STS., PHILADELPHIA 30, PA.

Power Switching Equipment: R&IE Equipment Div., Greensburg, Pa.
Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto
Export Sales: Philips Export Corp., N. Y.

circuit breakers • switchgear • unit substations • isolated phase bus structures • mechanical rectifiers • electronic components • special products.

The second of two articles on profits

What Are PROFITS Used For?

This is the second article on the role of profits in our economy. The first was addressed to the question: "How High are Profits?" The answer was found to be: not high when compared with previous years and the present investment in corporate facilities. This second article is addressed to the equally important question: "What do corporations do with their profits?"

In 1953 corporations will earn about $20 billion *after taxes*, if the recent rate of earnings is maintained throughout the year. These profits will be used (1) to expand and improve productive capacity through purchases of new plant and equipment, (2) to finance the operations involved in a growing volume of business and (3) to reward the people who have invested their money in American industry. Of the $20 billion, the corporations will pay about $9 billion to their stockholders as dividends. They will use the $11 billion that remains to purchase new plant and equipment and to increase their working capital.

This year corporations are increasing their plant, equipment and working capital by a total of approximately $32 billion. Of this amount, about $26 billion is for new plant and equipment. The remainder is for working capital. As this article will show in greater detail, about $21 billion of this will come from depreciation allowances and sales of new securities. The other $11 billion will come from retained profits.

It is impossible to trace exactly how each dollar of retained profits is spent. This money is mixed with other money that goes into the company treasury in the form of proceeds from loans, sale of securities and depreciation allowances. *However, it is a fact that by retaining $11 billion of their profits this year, corporations have provided $11 billion toward their total capital requirements, including the money needed for expanded and improved capital equipment.*

Profits Mean New Plants

This year American industry is engaged in a very large expansion of plant facilities. This will increase the industrial capacity of the nation by about 7 per cent. Since 1950, our capacity has been increased by about 12.5 per cent. And all of this expansion has been privately financed, even though about one-third of it was certified as necessary for national defense.

The expenditure during 1953 of $26

billion for new plant and equipment—an alltime record—imposes terrific financial responsibilities on our corporations. About one-half of the amount required will come from depreciation allowances. In general, these allowances are supposed to pay for the replacement of worn-out or obsolete equipment. Another $8 billion will be raised by corporations through new security issues and long-term mortgage loans. All together, depreciation allowances, security issues and long-term loans will provide about $21 billion. But this is still $5 billion short of the $26 billion needed for new plant and equipment this year. Thus, it is retained profits that spell the difference between expansion and standing still, between growth in the productive capacity of the economy and running downhill.

As plant facilities are expanded, corporations also need more working capital. A larger volume of business requires larger inventories, larger accounts receivable and larger amounts of ready cash to meet payrolls and bills for materials. The increase in these items during 1953 is estimated at $8.5 billion, of which about $2.5 billion will be supplied by short-term bank loans. The other $6 billion will come from retained profits. Thus, retained profits provide an essential $11 billion—$6 billion for working capital, $5 billion for new plant and equipment—to meet corporate financial requirements.

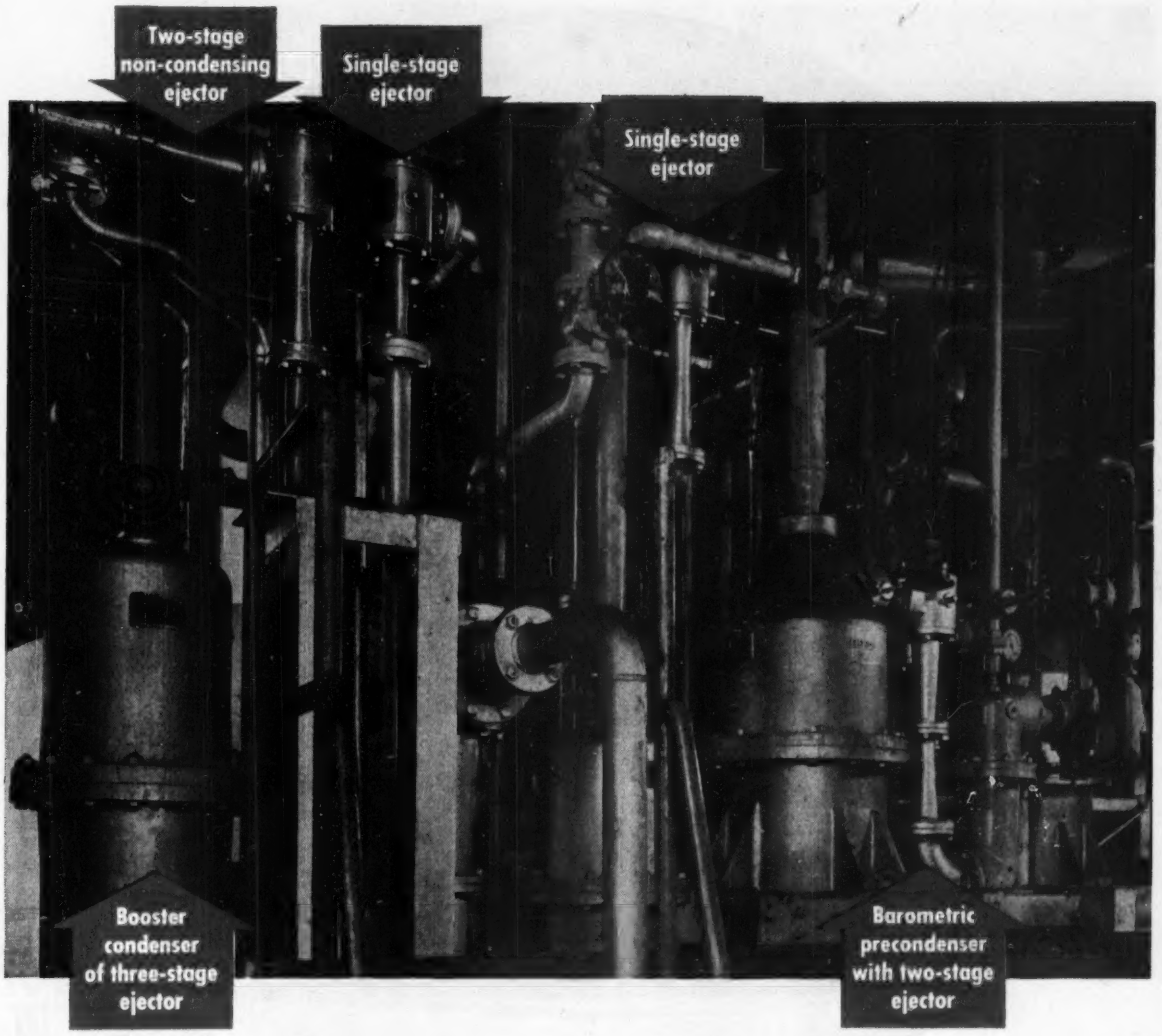
Incentive for Investment

The role of the profits that are paid to stockholders as dividends or to employees under profit-sharing plans is even more important than the role played by retained profits in providing plant, equipment and working capital. Dividend payments provide the main incentive for investment in the stocks of corporations. They are the reward for risks taken by investors. Dividends paid by corporations whose common stocks are listed on the New York Stock Exchange provide an average return of about 6.5% at present prices, and dividends on preferred stocks average about 4.5% return. Dividends are distributed among 6.5 million stockholders. Also, it is estimated that 3 million employees now are covered by profit-sharing plans. These plans increase the incentives of both production workers and managers to work harder and more efficiently.

Thus, more than 9 million Americans have a *direct* financial stake in corporate profits through ownership of stock or participation in profit-sharing plans. But *all* Americans share indirectly in the rewards of a successful business year. Investment of a major part of 1953 profits in new plants and equipment means more employment opportunities and better working conditions for labor. For the nation, it means new industrial capacity that is essential both for national defense and to produce more and better goods for a rising standard of living.

Corporate profits after taxes represent about 6% of the nation's total income. But the job they do to stimulate investment and to finance industrial expansion and improvement is more far-reaching and more essential to the prosperity and well-being of the American people than would be suggested by that small figure.

McGraw-Hill Publishing Company, Inc.



For VACUUM any way you want it-

ELLIOTT *Steam Jet* EJECTORS

Oil processing, for instance, may call for a variety of absolute pressures, in various ejector arrangements and sizes, with or without condensers. The photo above shows how the adaptability of Elliott ejectors, plus the "know-how" of Elliott ejector specialists, met the need in the plant of a nationally famous producer of edible oils. Processes included drying, hydrogenation and deodorizing.

If you have a condition requiring vacuum, the cooperation and experience of Elliott engineers, at your command, may be the short way to meet it. Contact your local Elliott representative or write Elliott Company, Jeannette, Pa. for descriptive bulletins.

ELLIOTT Company

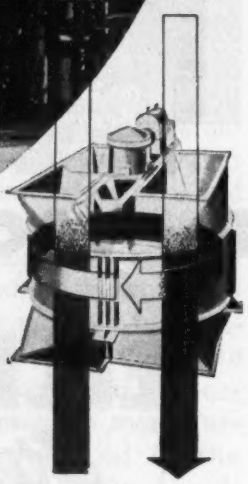
STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL BLOWERS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

03-4

INDUSTRIAL PROCESS DIVISION

with the

Ljungstrom Air Preheater



In every processing vessel that burns fuel, air preheat shows the way to save as much as *one barrel out of every five.* When refineries alone burn over 200,000,000 barrels every year, this means the *Ljungstrom Air Preheater* can recover tens of millions of *production dollars* that are now going up the stack.

The Ljungstrom removes precious BTU's from exit gases and transfers them to combustion air. Its effectiveness can be gauged from the fact that every 35-40°F of preheat means roughly a 1% saving in fuel—and Ljungstroms now in use preheat air to over 600°F.

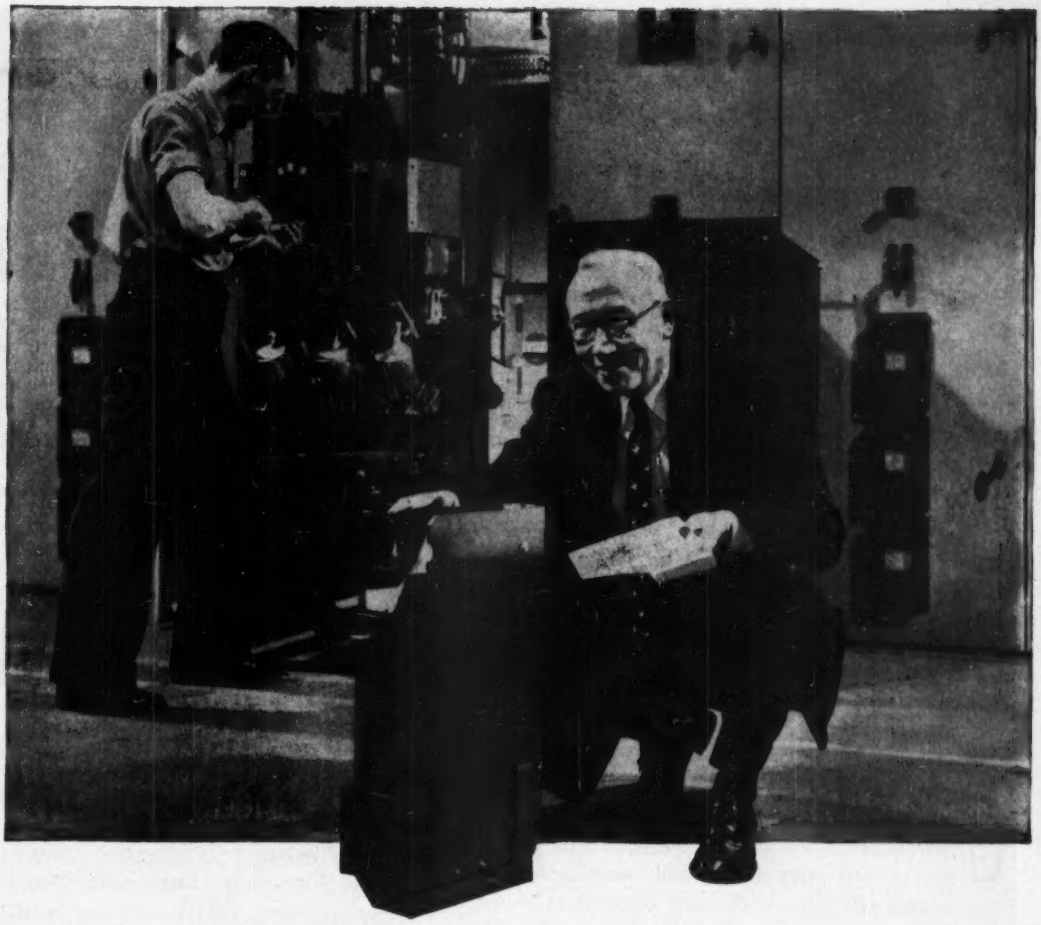
In addition to saving as much as 20% of your fuel, more effective fuel utilization means that your equipment can deliver greater throughput . . . can burn lower grade fuels with less slagging . . . lets you eliminate convection surfaces without reducing production.

In these days of high fuel costs, every process industry should consider the Ljungstrom for new installations or modernization of existing equipment. Call or write The Air Preheater Corporation for full details.

The Ljungstrom operates on the continuous regenerative counterflow principle. The heat transfer surfaces in the rotor act as heat accumulators. As the rotor revolves, the heat is transferred from the waste gases to the incoming cold air.

Wherever You Burn Fuel, You Need Ljungstrom

THE AIR PREHEATER CORPORATION 60 East 42nd Street, New York 17, N. Y.



How we combat corrosion and searing arcs

In most industrial plants, metal-clad switchgear is under constant attack—inside and out. To protect against the effects of arcing, Westinghouse lines arc chutes with a true ceramic containing a high percentage of *zircon,* which has the highest melting point of any known material.

Additional important factors in chute life that maintenance men appreciate: Westinghouse chutes will not absorb moisture, have dielectric properties comparable to porcelain.

This switchgear employs the most effective method of arc extinction in use today. The arc is extinguished in split seconds and it is on the main contacts for only a fraction of this time. Result: less contact burning, less chute wear, less shock to the whole unit.

Bonderizing® best practical surface protection

The best practical metal surface protection that we know of for switchgear is Bonderizing. We Bonderize our metal enclosures *after* they're assembled so that every nook and cranny gets the full five-dip treatment. Then the enclosures are painted twice and the paint sticks as though it is part of the metal.

In Westinghouse outdoor switchgear there's no worry about corrosion on the undersurfaces, either. After assembly, we spray them with a heavy layer of rubberized coating.

When you're planning switchgear installations, call in Westinghouse. And write now for your copy of booklet B-5306. Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

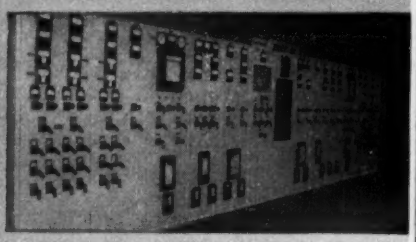
J-60820-C

YOU CAN BE SURE...IF IT'S Westinghouse

ALLIS-CHALMERS

MERCURY ARC RECTIFIERS

1. Two of these Allis-Chalmers outdoor oil circuit breakers guard the power entrance to the plant and two more serve as tie breakers. Each breaker is rated 3 cycle, 1200 amps, 161 kv, 7,500,000-kva interrupting capacity.



2. Duplex, tunnel-type main control board is located in rectifier room. It meters and controls all equipment in plant—from the 161-kv oil circuit breakers down to the mercury arc rectifiers and plant power substations.

For Non-Stop DC Power

It's Allis-Chalmers from 154-Kv Lines to Rectifiers in New Defense Plant

UNINTERRUPTED POWER is indispensable in the production of high purity chlorine and caustic soda in two mercury-type cell lines at the new Government-owned, Monsanto-operated plant at Sheffield, Alabama. To help meet this requirement, Allis-Chalmers supplied all of the switching, transforming and rectifying equipment.

Here's How Power Reaches Rectifiers

Under the guardianship of Allis-Chalmers 7,500,000-kva breakers, the 154-kv transmission voltage is stepped down to 13.8 kv by two transformers — each equipped for forced cooling so that either can supply the plant in an emergency.

Backed up by 1,000,000-kva breakers, the main 13.8-kv switchgear splits the electrical system into two plant power and two rectifier power sections — with bus-tie and other special provisions for reliability.

Final distribution for each plant power section is made by unit substations. Each rectifier power section goes through regulating and phase-shifting transformers and six rectifier transformers. The power is then carried through high-speed anode breakers to the 12-tube rectifier assemblies.

Incorporating many exclusive Allis-Chalmers features, the rectifiers operate in two banks of six assemblies each, to supply the two 30,000-amp cell lines.

A-C Engineering Can Serve You

For a complete rectifier plant or a single factory-packaged rectifier unit, you gain by calling in your A-C representative or writing to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3875

WITH ALLIS-CHALMERS *EXCITRON* RECTIFIERS

You Get These 10 Mercury Arc Rectifier Advantages

- Compact and light weight — need no special foundation.
- Push-button starting with no synchronizing.
- High power factor (lagging).
- Low idling loss and high conversion efficiency.
- High momentary overload capacity.
- Immunity to frequent short circuits.
- No major moving parts—provides low maintenance and assures quiet operation.
- No attendance needed during operation.
- Resistant to dust, moisture, fumes.
- Simple construction for long life.

PLUS These 6 Exclusive Allis-Chalmers Features

Fixed excitation anode — doesn't contact mercury and is independent of level, turbulence or impurities . . . requires no adjustment, maintenance or replacement.

Continuous excitation — pilot arc always present. Eliminates need for continuous, synchronized re-ignition. Enables rectifier to ride through severe ac voltage disturbances.

Grid phase control — in cleaner region near anode, where ion density is lowest.

Internal cooling system — high heat transfer with seamless-tube cooling coil located within the rectifier.

Arc-over free tube — insulating entire arc path eliminates danger of arcing-over to tube.

Enamelled anode seals — multi-layer fused vitreous construction provides high-strength seal unaffected by thermal variation.

3. Regulated power for each six assembly rectifier bank is obtained from an auto-regulating transformer (left) supplemented by a 32-step regulator. Two phase shifters (right) are also used for each bank of rectifiers.

4. Rectifier transformers are alternately connected wye and delta. This arrangement plus phase shifters results in each six-transformer bank providing a 36-phase system that minimizes communication circuit interference.

5. Rectifier room, containing twelve 6000-amp, 600-volt, 12-tube, *Excitron*-type rectifiers. Each is a factory-assembled unit, complete with built-on evacuating apparatus, water-to-water heat exchanger, and water circulating, control and protective equipment. (See list at left for six ***exclusive features*** of Allis-Chalmers *Excitron* rectifiers.) In picture above at left are the anode breakers; at right, the cathode breakers with disconnect switches; and in the center, the excitation compartments containing excitation, phase control, vacuum measuring, and protective equipment.

ALLIS-CHALMERS

Our Engineers Introduced Mercury Arc Rectifiers to U. S. Industry

G-E MOTOR CONTROL CENTER— 4 EASY-MAINTENANCE FEATURES

1 ACCESSIBLE UNITS (all components on one frame) are interchangeable, terminals front-connected.

2 LIGHTWEIGHT UNITS (Size 1 only 30 lbs.). To remove, just disconnect terminals. Stab-on connectors make bus ties automatically when replaced.

3 SAFE, EASY SERVICING in "disconnect position." Terminals easily reached; 4" vertical wiring trough.

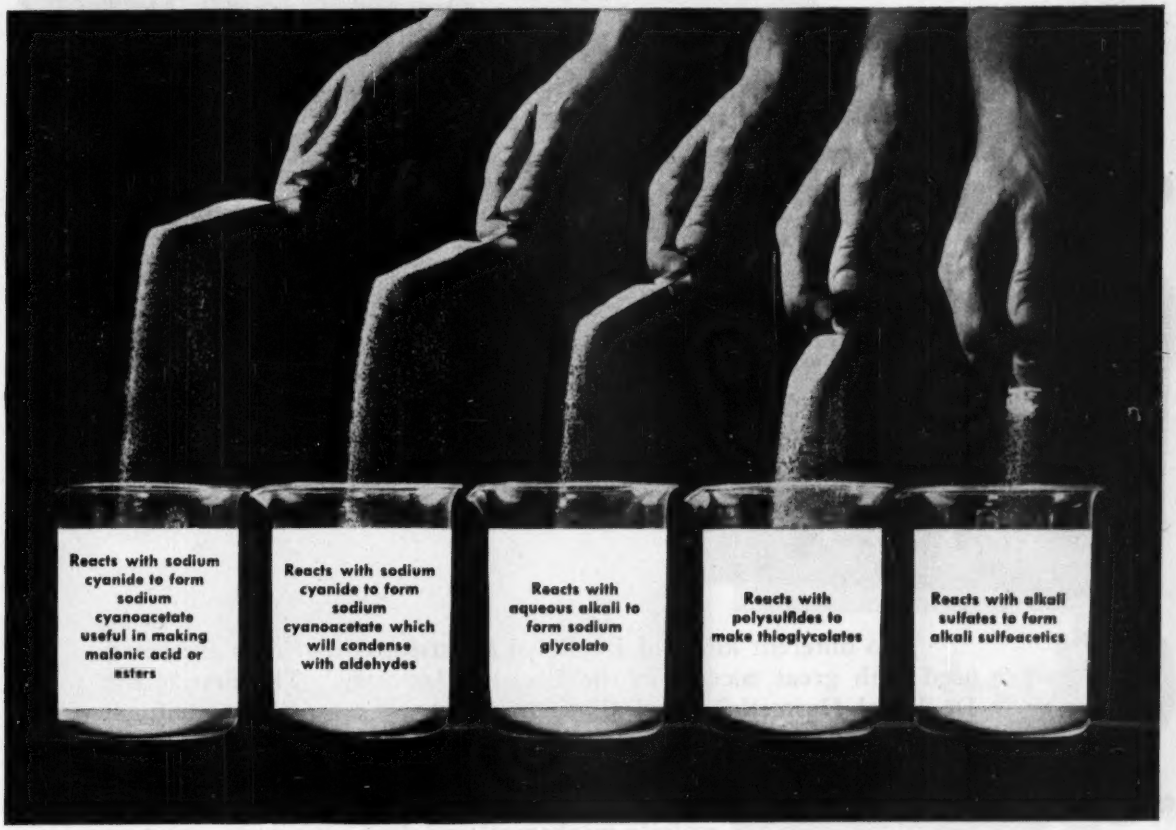
4 SAFE OPERATION even with some units being serviced. Personnel isolated from live bus by steel barrier.

For more information, contact your G-E Apparatus Sales Office or write for Bulletin GEA-4979A. Section 781-8, *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

AN INTERMEDIATE WITH MANY USES

SODIUM CHLOROACETATE, Tech.


Reacts with sodium cyanide to form sodium cyanoacetate useful in making malonic acid or esters
Reacts with sodium cyanide to form sodium cyanoacetate which will condense with aldehydes
Reacts with aqueous alkali to form sodium glycolate
Reacts with polysulfides to make thioglycolates
Reacts with alkali sulfates to form alkali sulfoacetics

Wide variety of reactions and ease of handling in processing enable this intermediate by DOW to work efficiently and capably in many industries

Sodium chloroacetate, Tech., by Dow is used as an intermediate in several different type reactions and chemical process applications. Investigate this product for your needs with assurance of top product quality and a dependable supply.

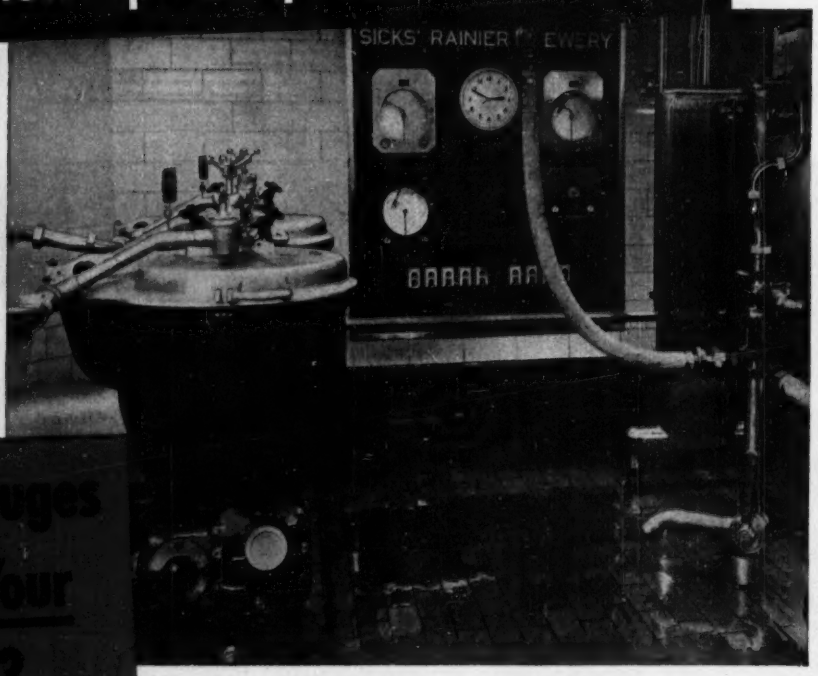
Sodium chloroacetate is a fine, white powder in a stable form for easier handling in processing.

Prompt delivery of this and your other chemical needs is assured by the widespread Dow distribution system. For an evaluation sample and further information, write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Dept. FC 3-23.

you can depend on DOW CHEMICALS

DOW

Centrifuges Now Speed Up Beer Brewing...



...Can Centrifuges Replace Your Filters?

Two different kinds of De Laval Centrifugal Clarifiers are being used with great success in the Brewing Industry. The first is the De Laval Hermetic® Wort Clarifier, which by means of centrifugal force removes trub from the wort. This removal of solids from liquid formerly was entrusted to diatomaceous earth filters. The centrifugal method is not only much faster but is a great deal more economical, for centrifugal action is entirely mechanical and does not require constant replacement of any essential element.

The second De Laval Centrifugal aiding the brewmaster today is the Beer Clarifier, used to clarify the almost-finished beer. The De Laval Beer Clarifier replaces another filter—and as in the case of wort clarification, effects great savings in time and operating cost.

What De Laval Centrifugal machines have done for the Brewing Industry they well might be able to do for ***yours.***

De Laval

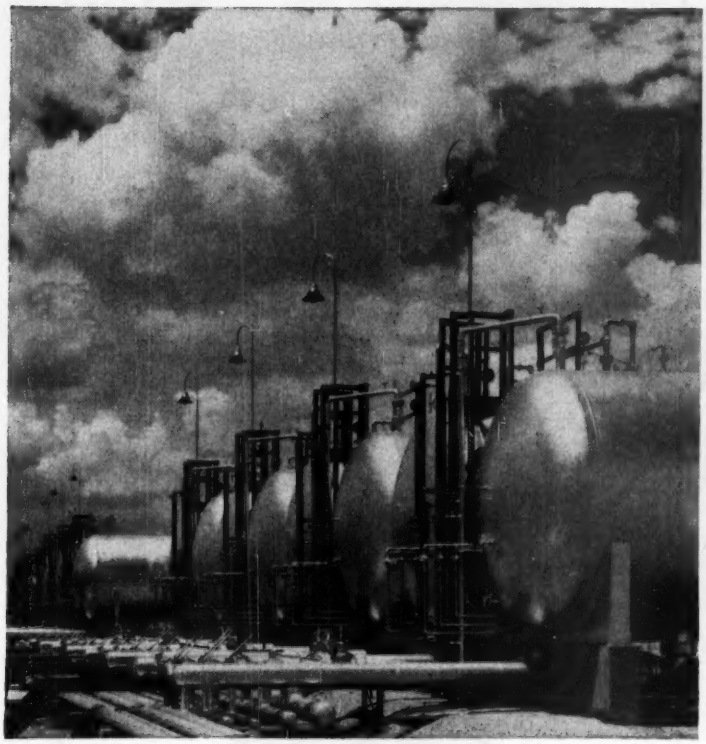
THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

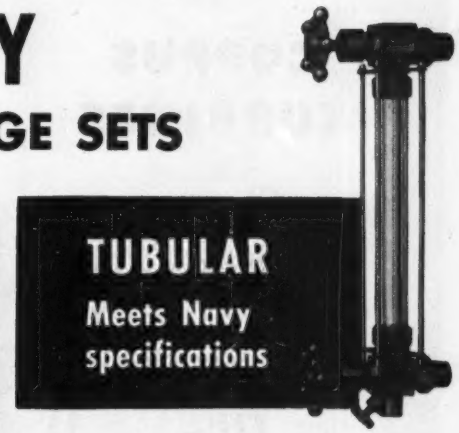
FOR FASTER PROCESSING SYSTEMS

For any pressure... in any length

SPECIFY PENBERTHY

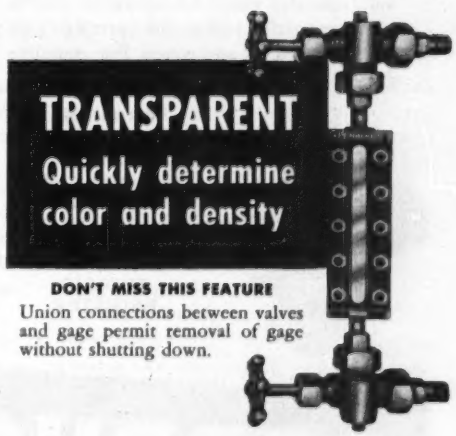
LIQUID LEVEL GAGE SETS





TUBULAR
Meets Navy specifications

REFLEX
Accurate, easy-to-read



TRANSPARENT
Quickly determine color and density

DON'T MISS THIS FEATURE
Union connections between valves and gage permit removal of gage without shutting down.

Corrosion-resisting Penberthy gages and valves indicate accurately the level in vessels containing any kind of liquid. Construction is exceptionally sturdy. Materials conform to or exceed requirements of A.I.S.I., A.S.T.M. and/or A.P.I.-A.S.M.E. for maximum recommended pressures and temperatures. They are made from carbon steels, high grade bronze and malleable iron. Also available are chrome-moly and stainless steels and Monel metal. When specified, materials such as acid bronze, Everdur, nickel and Hastelloy are supplied.

For your special requirements, experienced engineering counsel and service are available to design and make valves and gages to meet your unusual conditions.

● For most requirements, Catalog 35 is a handy help in selecting and ordering. A copy will be sent upon request.

Established 1886

PENBERTHY INJECTOR COMPANY
Division of the Buffalo-Eclipse Corporation
1263 Holden Avenue, Detroit 2, Michigan

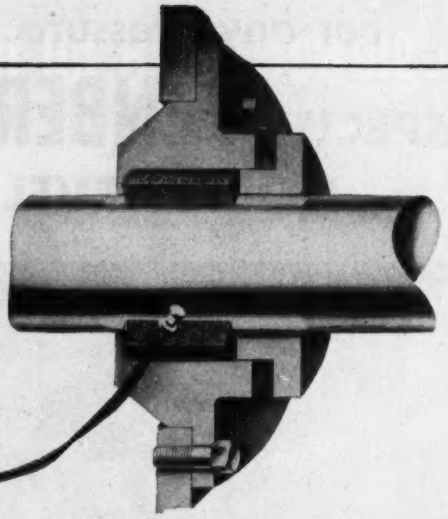
***There's Certain satisfaction in* PRODUCTS BY**

PENBERTHY

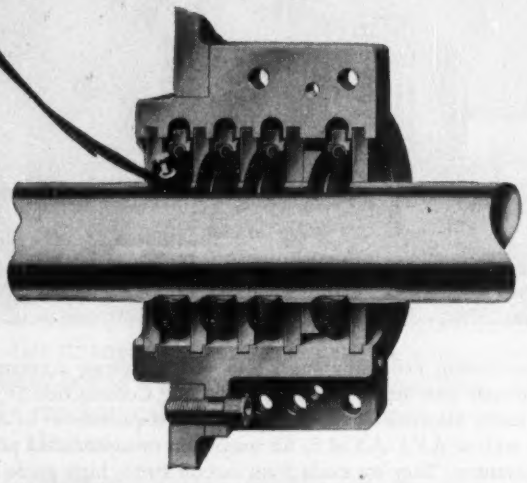
- CYCLING JET PUMPS
- EJECTORS
- INJECTORS
- ELECTRIC SUMP PUMPS
- EDUCTORS
- EXHAUSTERS
- SYPHONS

COPPUS TURBINES

offer you a choice of packing rings



STANDARD METALLIC RING PACKING — Made of high grade asbestos cores encased in specially treated lubricated aluminum foil. Recommended as a low-friction, long-service packing for steam temperatures up to 850 F and back pressures up to 50 lb. Adjustable packing glands keep leakage at minimum. Easy access to packing rings.



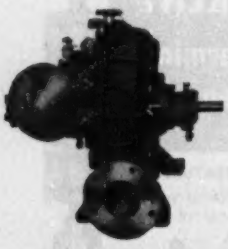
OPTIONAL CARBON RING PACKING — Consists of three carbon packing rings on the pressure side and one beyond the leak-off section. Each ring has three segments held together by a stainless steel garter spring. For back pressures up to 75 lb. Standard for vacuum or gas operation, or when leak-off is desired.

Heavy chrome plating on shaft at stuffing box is common to both types of Coppus packing.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

FIT TURBINE COSTS TO HORSEPOWER NEEDS

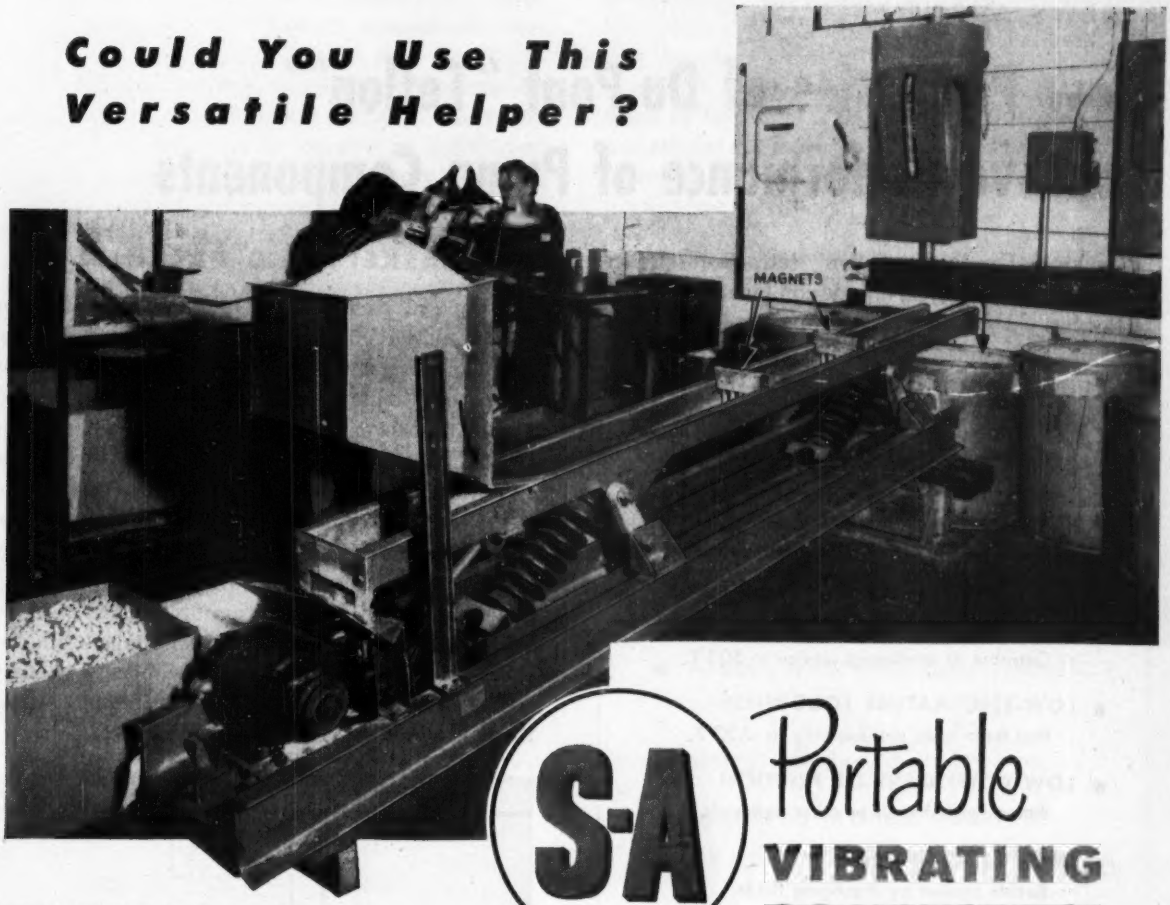
When you buy turbines rated close to your exact horsepower needs, you save plenty of money. That's because turbines are generally priced in proportion to their size. The wide range of sizes of Coppus Turbines promises purchasing economy for you from the 150 hp size down to the smallest. As for operating and maintenance economies, you get them, too, from such other features as: greater number of manually operated valves for individual control of steam nozzles; replaceable cartridge-type bearing housings and others. For complete details . . .



WRITE FOR BULLETIN 135
COPPUS ENGINEERING CORPORATION
232 Park Avenue
Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

COPPUS "BLUE RIBBON" TURBINES

Could You Use This Versatile Helper?



LEMAC COMPANY, Los Angeles, Calif.
S-A Natural Vibrating Frequency Conveyor as used for salvaging plastic

S-A Portable VIBRATING CONVEYOR

shows up defective parts and salvages usable plastic . . .

REDLER Conveyor-Elevators
ZIPPER Conveyor-Elevators
Vibrating Conveyors
Belt Conveyors
Screw Conveyors
Bucket Elevators
Pan Conveyors & Feeders
Circular Bin Dischargers
Centrifugal Loaders & Pilers
TELLEVEL Bin Level Controls
Ship Loaders & Unloaders
Storage & Reclaiming Systems
Box Car Loaders & Unloaders
Bin Gates, All Types
SEALMASTER Ball Bearing Units

You're likely to find this conveyor unit in any part of the Lemac Company plant. It serves in turn as a feeder, sorting table and salvage collector.

As a sorting table it rests horizontally on the floor. Vibrating at the natural frequency of its coil springs, it turns plastic parts over and over as they are conveyed along. Girl inspectors can quickly spot and remove defectives.

One of the Lemac Company's products is a plastic spray nozzle with a stainless steel ball valve. To salvage the plastic from defective units, they are first crushed to break the ball, causing it to become magnetic. The mixture of broken plastic and balls is gravity fed to the S-A Conveyor, where magnets hung over the trough remove the broken balls. Unbroken, non-magnetic balls which escape the crusher, roll backwards down the trough to a container at the feed end. With all metal safely removed the plastic can be reused in the injection molding machines.

Wherever there's a handling need . . . for a conveyor or a complete conveying system—to cut costs or simplify operations—S-A engineers are trained and experienced in finding the most economical and practical answer. See if we can't help *you*. Write for a free survey.

STEPHEN S-A DAMSON MFG. CO.
3 Ridgeway Avenue, Aurora, Illinois — Los Angeles, Calif., Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

NEWS ABOUT "TEFLON"

How Properties of Du Pont "Teflon"* Improve Performance of Pump Components

Ever since Du Pont "Teflon" tetrafluoroethylene resin was developed, its unique combination of properties has led to an ever-increasing use as a material for pump components—gaskets, packings, impellers, bearings. Among these properties—of particular value to manufacturers *and* users of pumps—are:

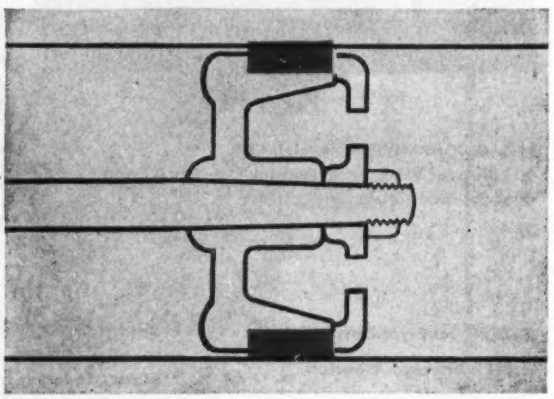
- **CHEMICAL INERTNESS**
  Du Pont "Teflon" is completely inert to all chemicals and solvents, except molten alkali metals and fluorine at elevated temperatures and pressures.
- **HEAT RESISTANCE**
  Capable of continuous service to 500°F.
- **LOW-TEMPERATURE TOUGHNESS**
  Has been used satisfactorily to -320°F.
- **LOW COEFFICIENT OF FRICTION**
  Either against itself or other materials.
- **EROSION RESISTANCE**
  Resists erosion by impinging fluids.
- **ZERO MOISTURE ABSORPTION**
- **NON-ADHESIVENESS**
  The tackiest materials show little tendency to stick to "Teflon."

Here are some examples that show how pump components of Du Pont "Teflon" give outstanding performance and long service life...decrease production downtime, provide important savings in labor and material.

GASKETS AND PACKINGS

Gaskets and packings of Du Pont "Teflon" have been used satisfactorily in numerous pump applications, handling corrosive chemicals under extremely severe conditions. In each case, they have given outstanding performance—often outlasting the pump itself. "Teflon" is superior in chemical resistance to any other known gasket or packing material. It has lasted up to 300 times longer than other materials.

Service records of one pump user showed that the first set of packings in a horizontal duplex pump handling a 50% concentration of NaOH at 270°F. lasted only 73 days, the second set 38 days, and the third only 16 days because the cylinder was badly scored. The cylinder was then honed, and packing rings of Du Pont "Teflon" were installed.



After 5 months' operation, these rings were still in good condition and there were no signs of wear on the cylinder or packing.

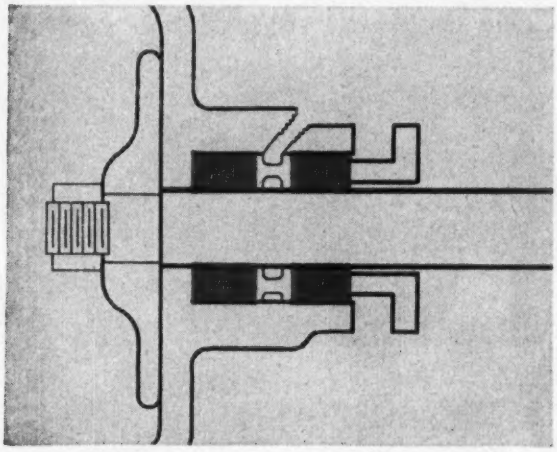
PUMPS WITH COMPONENTS OF DU PONT "TEFLON" ARE BEING USED BY MANUFACTURERS AND PROCESSORS OF:

chemicals	fertilizers	petroleum	rubber
chlorine	foods	pharmaceuticals	soap
dyes	insecticides	photographic film	sugar
explosives	paper	plastics	textiles

AND BY MANUFACTURERS ENGAGED IN:

etching	pickling	refining
electroplating	tanning	of metals

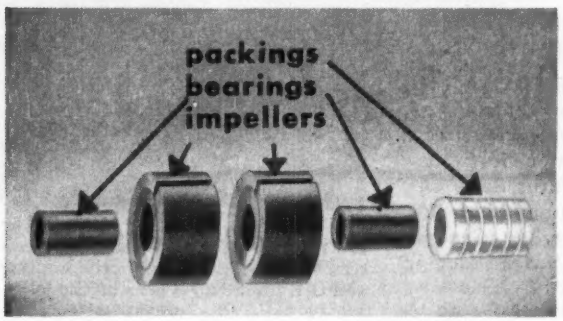
In other cases, the gains in productivity found with components of "Teflon" overshadow cost of packing replacement. Typical is a centrifugal pump used to pump hot "butyl extract," a mixture of sulfuric acid and petroleum fractions. This pump has a 2-inch shaft and is operated at 3,500 rpm. Records showed the pump leaked badly, requiring almost constant maintenance. The shaft was badly scored, needing a new shaft sleeve every few days.



When a packing of Du Pont "Teflon" was installed, leakage was greatly reduced. Packing and shaft sleeve were in good condition after several months' operation.

IMPELLERS AND BEARINGS

In addition to the range of its use in gaskets and packings, Du Pont "Teflon" is also giving excellent performance in impellers. Corrosion and erosion of this rapidly moving pump component are accelerated by the impinging of corrosive fluids, often causing the impeller to be the first element of the pump to fail. The chemical inertness and erosion resistance of "Teflon" greatly reduce these attacks. For these properties plus a low coefficient of friction, bearings of "Teflon" are used in the same pump.



The impellers, bearing and packings used in this positive-displacement chemical pump are made of Du Pont "Teflon." Through the unique combination of properties of "Teflon," the range of chemicals the pump can handle has been greatly extended. The impellers are strong enough to withstand high tangential loads. They won't gall, shrink, swell, crack or harden. The bearings need no lubrication and are not subjected to erosive pitting even when operated in acids. The packings also give long, trouble-free service.

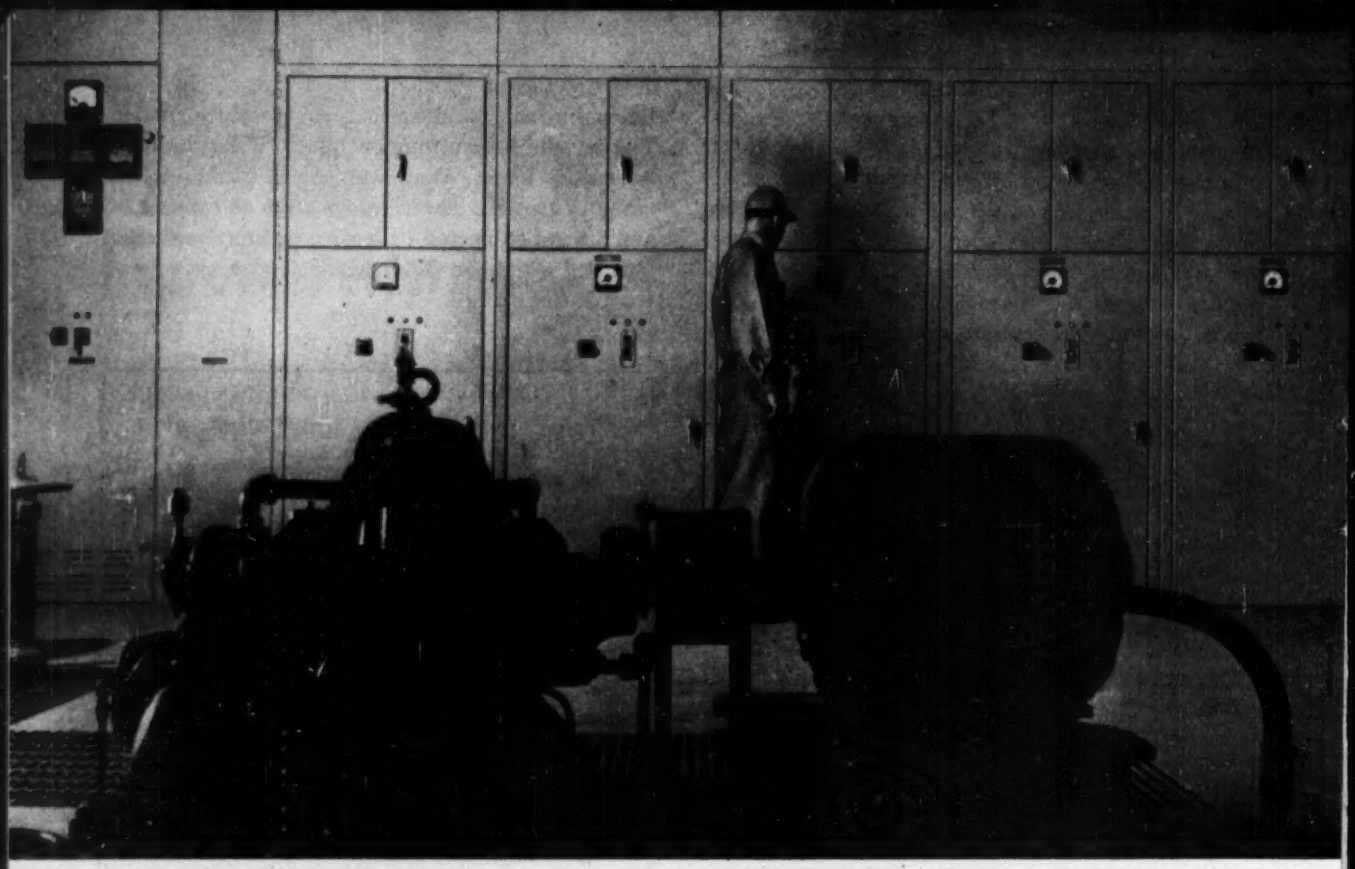
COMPONENTS OF DU PONT "TEFLON" IN PROCESS EQUIPMENT CAN MEAN:

- less maintenance
- less replacement cost
- increased productive capacity —through less downtime
- reduce wear—on pistons, shafts, etc.
- simplified design
- improved product quality— by eliminating contamination

The Polychemicals Department of the Du Pont Company supplies "Teflon" in the forms of molding powders and aqueous dispersions. These forms are converted into various components for pumps, valves and other process equipment by a number of manufacturers. For further information write: E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 2512, Du Pont Bldg., Wilmington 98, Delaware.

*REG. U. S. PAT. OFF.

DU PONT
TEFLON®
Plastic
Better Things for Better Living
. . . through Chemistry



G-E LIMITAMP CONTROL stands ready to check short-circuit conditions from high-voltage overloads on synchronous and induction motors up to 4800 volts. Limitamp's high interrupting capacity prevents equipment damage and costly shutdowns.

G-E Limitamp Control means "safety first" for personnel and high-voltage equipment

PROTECT YOUR EQUIPMENT from the explosive and shattering effects of sudden electrical overloads with General Electric Limitamp control . . . and be assured of equipment protection against short-circuit conditions up to 250,000 kva.

With General Electric Type EJ-2 fuses, fault current is limited in less than ¼ cycle . . . and the air-break contactor offers rugged service for millions of operations.

SAFEGUARD YOUR PERSONNEL by taking advantage of G-E Limitamp's "safety first" features. High- and low-voltage compartments are separated by a steel barrier. A mechanical door interlock assures opening of the motor circuit before the fuse compartment can be opened.

FOR YOUR OWN REQUIREMENTS, individual components need not be specified. Our application engineers select the correct components to give you proper control and sufficient interrupting capacity.

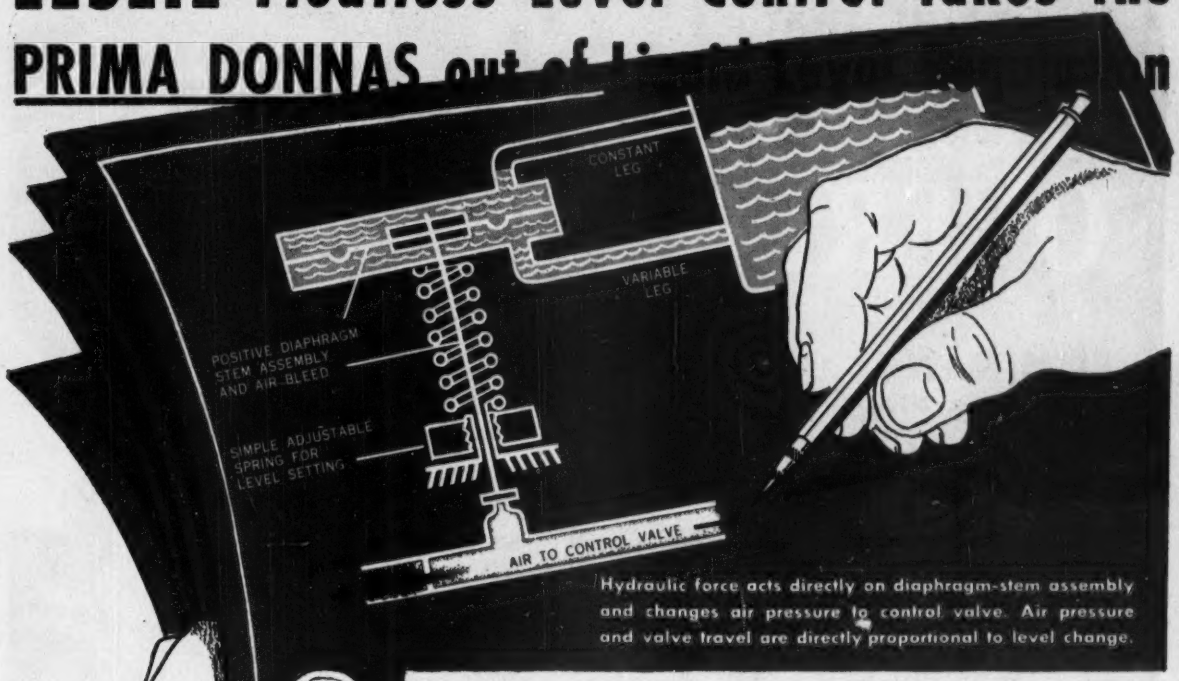
FOR COMPLETE INFORMATION about G-E Limitamp controls and how your particular operation can benefit, contact your nearby General Electric Apparatus Sales Office, or write Section 781-6 for Bulletin GEA-5409 today. *General Electric Company, Schenectady 5, New York.*

EASY TO MAINTAIN. Arc shutes are easily removed, contact tips quickly inspected, and G-E Limitamp is back on the job.

You can put your confidence in—

GENERAL ELECTRIC

LESLIE *Floatless* Level Control takes the PRIMA DONNAS out of


CONSTANT LEG
VARIABLE LEG
POSITIVE DIAPHRAGM STEM ASSEMBLY AND AIR BLEED
SIMPLE ADJUSTABLE SPRING FOR LEVEL SETTING
AIR TO CONTROL VALVE

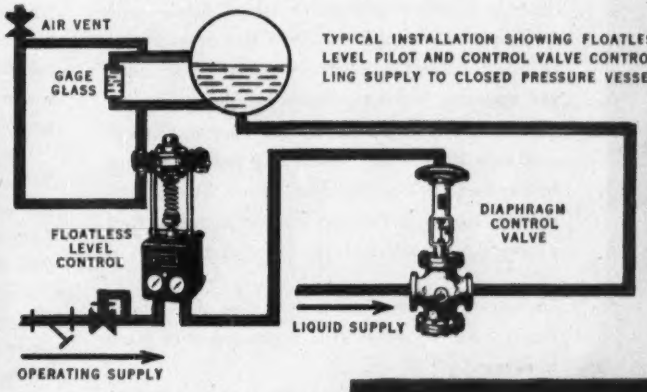
Hydraulic force acts directly on diaphragm-stem assembly and changes air pressure to control valve. Air pressure and valve travel are directly proportional to level change.

Here is level control that is not affected by surface agitation, equipment vibration, or the roll of a ship—a simple design that provides steady, positive, precise control even under extreme conditions.

Thousands are in service today, providing accurate control of liquid level (plus or minus 1″ water column) and eliminating the problems caused by troublesome linkages, torque tubes, floats and stuffing boxes.

Note these special features—

1. **Can be installed anywhere below liquid level . . . on control panel, if desired.**
2. **Simple, compact, one adjustment unit . . . weighs only 40 lbs.**
3. **Diaphragm stem assembly is only moving part. Diaphragm element doesn't require recalibration during service.**



TYPICAL INSTALLATION SHOWING FLOATLESS LEVEL PILOT AND CONTROL VALVE CONTROLLING SUPPLY TO CLOSED PRESSURE VESSEL.

SEND FOR DESCRIPTIVE DATA PC-37

When specifying . . .

Here's *another* LESLIE *standard* item to fit specifications that are *special* orders with most manufacturers. When specifying pressure, temperature or level controls—for new or replacement service—it will pay to check *first* with your nearest LESLIE engineer. He's listed in the classified telephone directory in principal cities . . . under "Regulators" or "Valves"

7527

LESLIE

TOPS IN QUALITY PRESSURE LEVEL AND TEMPERATURE CONTROLS

Since 1900

LESLIE CO., 279 Grant Avenue, Lyndhurst, New Jersey

THE DRIVE THAT

GUARDS AGAINST OVERLOADS

ELIMINATES...
Shear-Pins
...Electrical
Overload
Relays

Philadelphia
WORM GEAR REDUCERS
with "Torque Control"

Here is a worm gear drive which safely and surely protects against overload damage to conveyor assemblies and other industrial machinery yet operates without the use of shear pins or electrical overload relays. The *Torque Control* unit may be set for almost any predetermined torque—when this loading is exceeded the driving motor is instantaneously stopped, thus protecting the entire train of equipment.

To restart, only removal of the cause of overload is required. No resetting or replacement of parts is necessary.

The *Torque Control* unit was initially developed for the conveyor industry—its highly successful use in this field has led to its application on a wide range of industrial machinery where instant protection against overload or jamming is necessary.

Torque Control may be incorporated on any of the standard line of Philadelphia Worm Gear Speed Reducers in horsepower ratings up to 260 HP and ratios to 6300:1.

Torque Control is another example of advanced power transmission engineering by Philadelphia. Write us for full details.

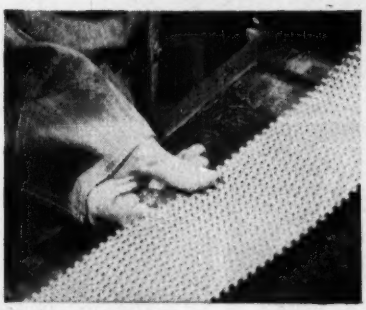
Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

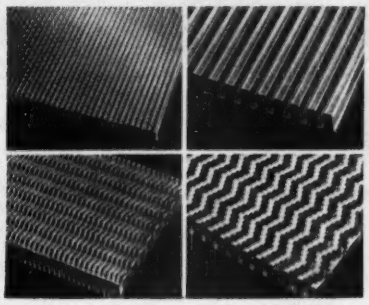
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

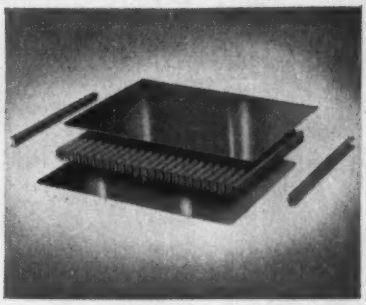
Here's how Trane brazes aluminum to solve tricky heat transfer problems...



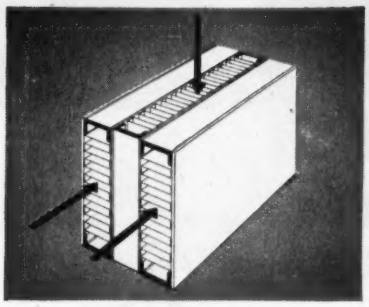
Corrugated fin surface for TRANE Brazed Aluminum Exchangers is formed in special presses from aluminum brazing sheet. Thickness can range from .005 to .032 inch; fin height to .50 inch; spacing 4 to 18 fins per inch.



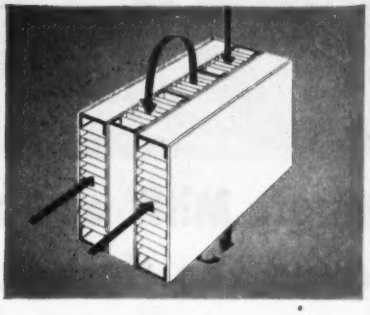
Many types of surface available. The brazed aluminum fins may be straight and continuous. Or they can be wavy, serrated or perforated to provide correct ratio of heat transfer to pressure drop



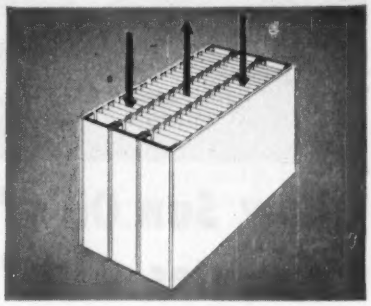
Exploded view shows component parts of a single passage. Fins, channels and parting sheets, all made from aluminum brazing sheet, become integrally bonded when assembled unit is submerged in a molten salt flux bath.



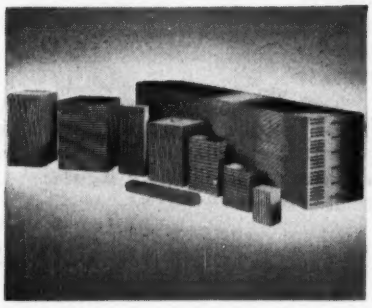
Cross-flow arrangement has fins in adjacent passages running crosswise to each other. TRANE Brazed Aluminum Surface can pack 450 square feet of heat transfer surface into one cubic foot of space.



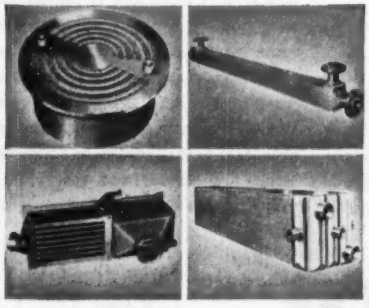
Multi-pass arrangement, like the cross-flow type, has fins in adjacent passages running crosswise to each other. With this arrangement, however, alternate passages are constructed to produce multiple passes.



Counter-flow arrangement has fins in adjacent passages running parallel to each other. A wide variety of different types of corrugated fin sheets can be used to handle different fluids in the same exchanger.



A wide range of core sizes is available up to 106 inches in length. Either bolt-on or integrally welded headers can be provided. Individual cores can be welded together to form larger multi-core units.



Design flexibility permits construction of units to handle practically any specification of heat transfer, pressure drop, volume, number and direction of passes. Some units handle as many as six different fluids simultaneously!

TRANE

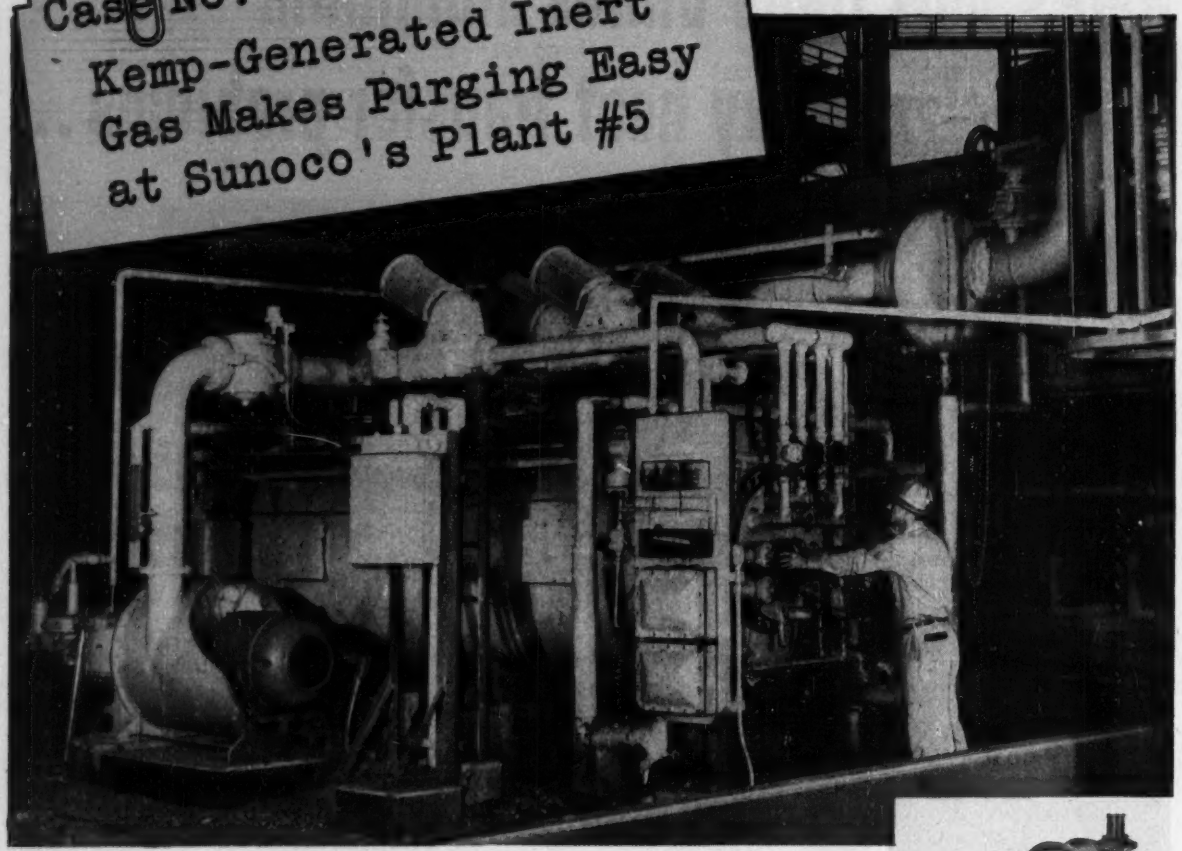
pioneers in the science of heat exchange

If you have a tricky problem in heat transfer . . . TRANE Brazed Aluminum Exchangers may be the answer. Contact your TRANE Sales Office or write direct.

The Trane Company, La Crosse, Wis. • East. Mfg. Div., Scranton, Penn. • Trane Co. of Canada, Ltd., Toronto. 80 U.S. and 14 Canadian Offices

Case No. 57

Kemp-Generated Inert Gas Makes Purging Easy at Sunoco's Plant #5



How Sun Oil's "Magic Mill" at Toledo operates with 'round the clock safety

There's no *one* word that strikes terror in the hearts of oilmen everywhere more quickly than F-I-R-E! To combat this threat at the Sun Oil Co.'s giant refinery at Toledo, Ohio, constant vigilance, checks and inspections are the answer. And the liberal use of inert gas for purging pipelines, tanks and crackers is essential to this safety maintenance.

Kemp selected to do the job

When plans called for *doubling* plant production in 1950, a new Kemp Generator (see above) was installed to insure adequate inert gas production. Fast-starting, easy-to-operate, this Kemp unit more than filled the bill. Today tanks and lines are periodically purged for inspection and cleaning *as often as needed*. And thanks to its 60,000 cu. ft. per hr. Kemp Inert Gas Generator, Sunoco enjoys *exact analysis* inert production that meets all its purging requirements.

Let Kemp help you, too

If you have a purging or blanketing problem, why not let Kemp Engineers give you the same helpful advice used so profitably at Sun Oil's Toledo refinery. It costs you nothing to investigate. And it may save you money. Find out how Kemp's wide range of dependable, low-cost Generators (complete with the latest fire checks and safety devices) offer you the best way to solve your problems.

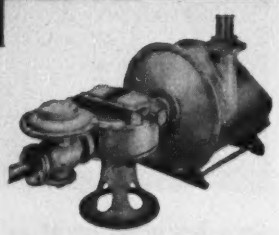
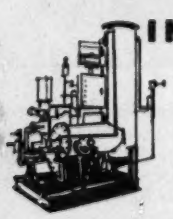


Photo above shows close-up view of Kemp Industrial Carburetor, the heart of every Kemp Installation. Assures complete combustion... without waste, without tinkering. Reduces installation costs, simplifies maintenance.

For more complete facts and technical information, write for Bulletin I-10 to:
C. M. KEMP MFG. CO., 405 E. Oliver Street, Baltimore 2, Maryland.

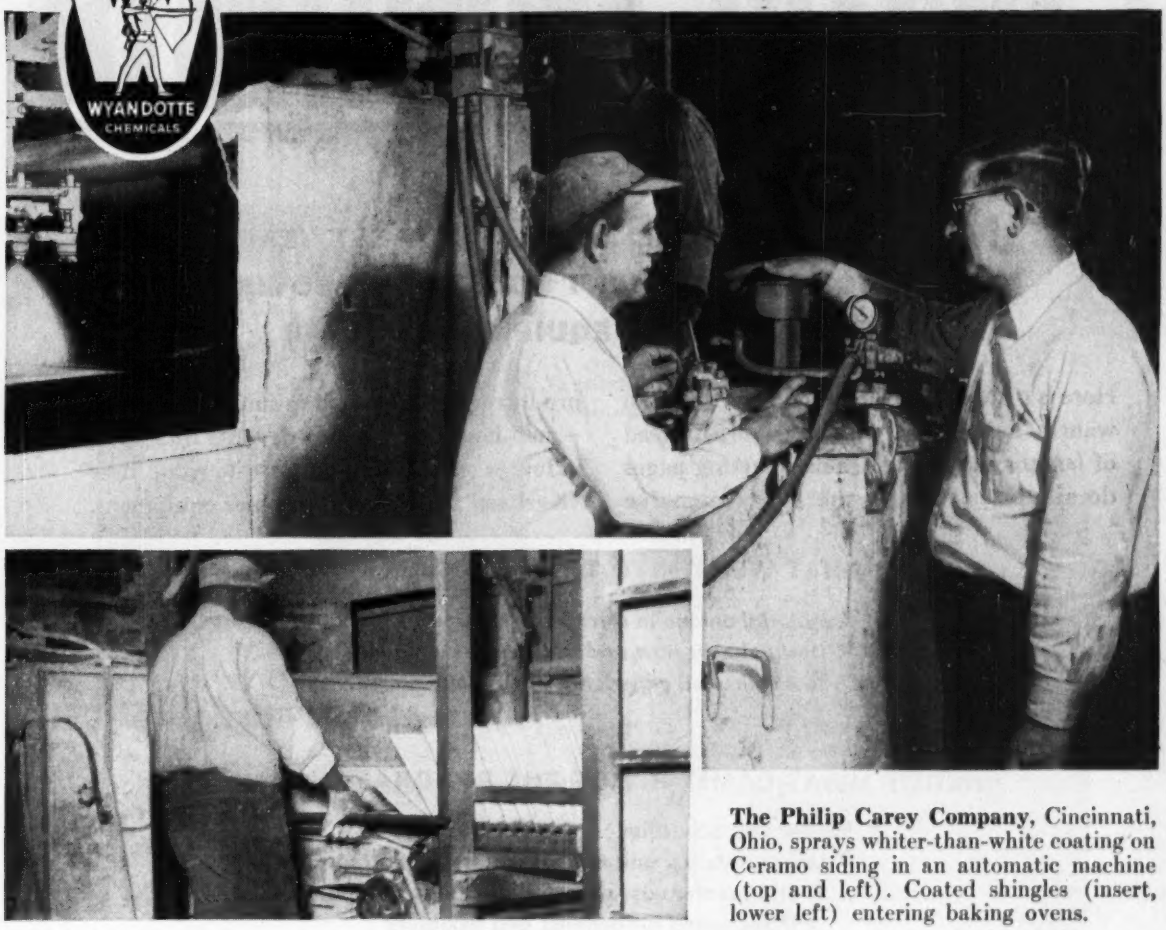
KEMP OF BALTIMORE



INERT GAS GENERATORS

CARBURETORS • BURNERS • FIRE CHECKS
METAL MELTING UNITS • ADSORPTIVE
DRYERS • SINGEING EQUIPMENT

Dependable Source of Chemical Raw Materials



The Philip Carey Company, Cincinnati, Ohio, sprays whiter-than-white coating on Ceramo siding in an automatic machine (top and left). Coated shingles (insert, lower left) entering baking ovens.

How Wyandotte Purecal helps make world's whitest Ceramic Siding

Ceramo, used as sidewalls in a new or old home, is the miracle material of the building industry. It won't burn, rot, warp, crack, or curl, and washing with ordinary soap and water keeps it looking sparkling white, year after year.

Ceramo is an exclusive product of The Philip Carey Manufacturing Co., Cincinnati, Ohio.

It is a ceramic-glazed, asbestos-cement siding of unusual whiteness. In fact, light reflectivity tests, recommended by U.S. Bureau of Standards, rate Ceramo 90.7%. Published figures rate lead zinc white paint, 2 coats —66% . . . titanium oxide white paint — 75%.

To get a lasting white finish, requires not only highest quality ingredients but also a white-white extender and a practically permanent coloring agent. Wyandotte PURECAL* is both! PURECAL is Wyandotte's precipitated calcium carbonate — the whitest pigment extender known . . . completely free from the metallic impurities that cause discoloration upon aging.

This manufacturer's experience has been that Wyandotte PURECAL serves both these prime purposes more economically than any other ingredient of comparable quality.

How about your business? Can you profit from PURECAL as an extender in paint, paper, rubber, or in your new products? Write Wyandotte for free samples and data. State your requirements—our Research Department may have valuable data for you. *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Offices in principal cities.*

*Reg. U.S. Pat. Off.

Wyandotte

CHEMICALS

HEADQUARTERS FOR ALKALIES

Soda Ash • Caustic Soda • Bicarbonate of Soda • Chlorine
Calcium Carbonate • Calcium Chloride • Glycols • Synthetic
Detergents • Agricultural Insecticides • Soil Conditioners
Other Organic and Inorganic Chemicals

TWELVE MONTHS OF

NATIONAL CARBON'S GREATEST YEAR OF PRODUCT DEVELOPMENT BOOSTS THE BUYING POWER OF *YOUR* EQUIPMENT DOLLAR

Here is recommended reading for those who want a dollar that will buy *more* instead of *less* than a year ago. These catalog pages detail the results of the most intensive product-development program in our history—man-hours and money devoted to adding value *in every way possible* to your new "Karbate" impervious graphite equipment.

HERE'S WHAT WENT INTO THE PROGRAM:

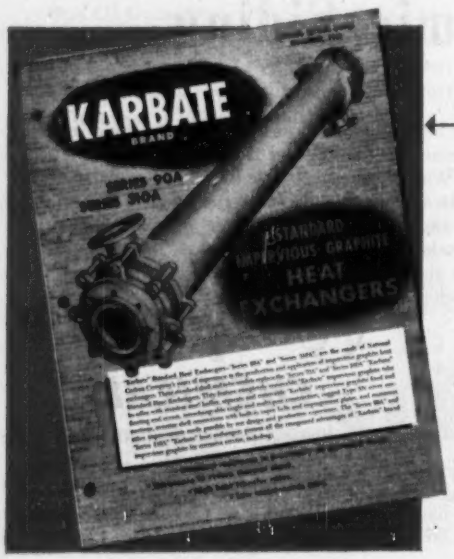
- A *material* unique in corrosion resistance
- *Design* know-how and facilities pre-eminent in the field
- *Application experience* of long standing

HERE'S WHAT CAME OUT OF THE PROGRAM:

- Higher unit capacities
- Lower costs per unit of product through increased efficiency
- Still greater ease of installation and maintenance
- Increased ruggedness and flexibility
- Greater simplicity and alterability than ever before

SEE THEM AT THE CHEMICAL SHOW • NOV. 30—DEC. 5

CONVENTION HALL, PHILADELPHIA, PA.

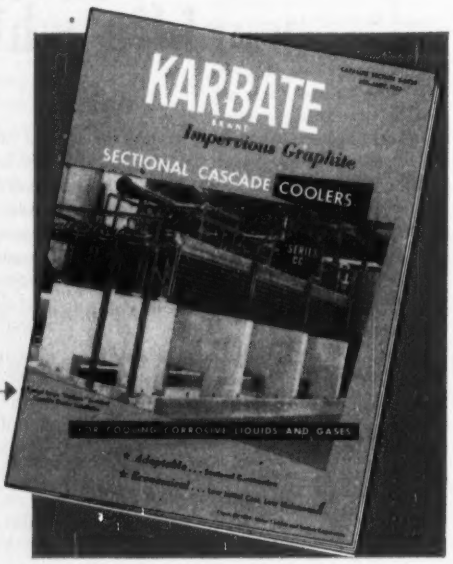


Catalog Section S-6740—HEAT EXCHANGERS

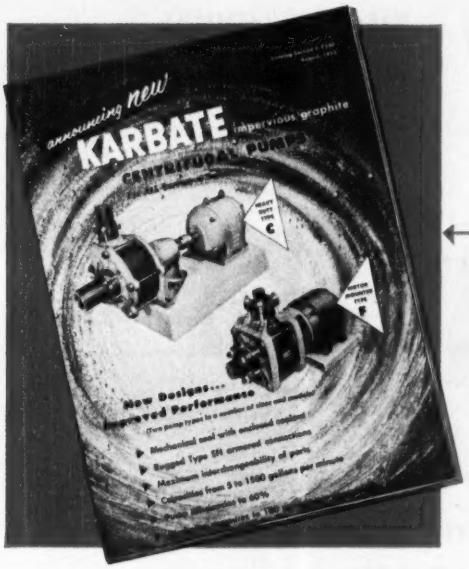
Chemical resistance to practically all corrosive fluids; resistance to severe thermal shock; high heat-transfer rates; low maintenance costs.

Catalog Section S-6820—CASCADE COOLERS

Low initial cost; radiused returns for low pressure drop; redwood water-guide strips; three standard models in stock.



PROGRESS IN VALUE!

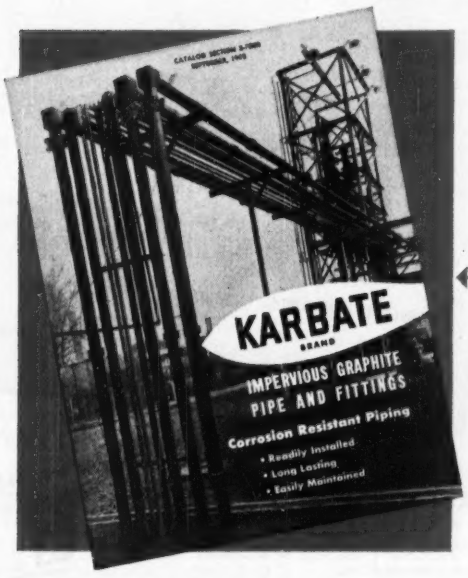


Catalog Section S-7250 – CENTRIFUGAL PUMPS

Capacities from 5 to 1500 G.P.M.;
type SN armored connections;
pump efficiencies to 60%;
discharge pressures to 100 psi.

Catalog Section S-7460 – HCL ABSORBER

Produces up to 20 tons per day 22° Baumé Acid;
pneumatic automatic control; compact, lightweight;
minimum installed cost.



Catalog Section S-7000 – PIPE AND FITTINGS

Readily installed; long lasting;
easily maintained;
unaffected by most corrosive fluids.

Send for literature today!

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

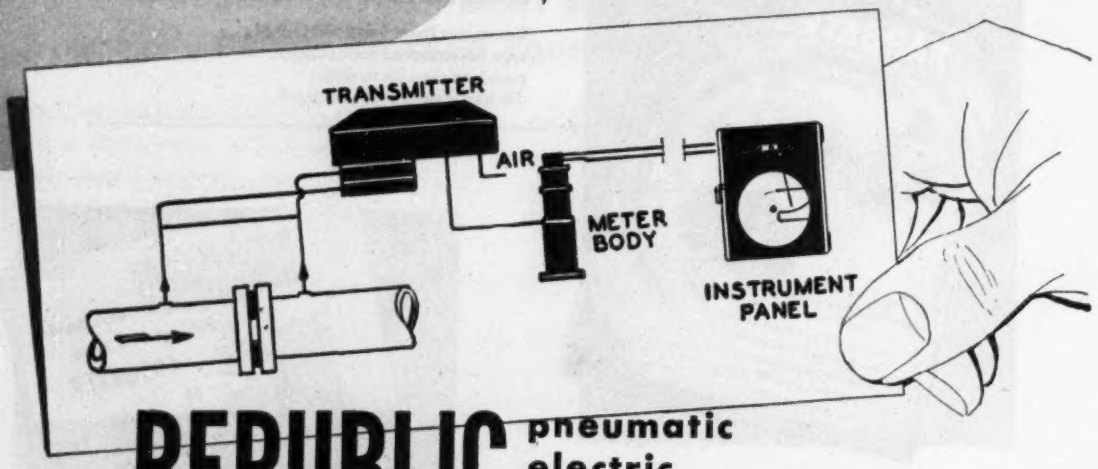
District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
IN CANADA: National Carbon Limited, Montreal, Toronto, Winnipeg

NATIONAL CARBON PRODUCTS

HEAT EXCHANGERS • PUMPS • VALVES • PIPING • TOWERS • TOWER PACKING • SULPHURIC ACID CUTTERS
HYDROCHLORIC ACID ABSORBERS • STRUCTURAL CARBON • BUBBLE CAPS • BRICK • GRAPHITE ANODES • BRUSHES

DO YOU HAVE THESE METERING PROBLEMS?

- TOXIC OR FLAMMABLE FLUIDS
- CORROSIVE FLUIDS
- DIRTY FLUIDS
- VISCOUS LIQUIDS
- WIDELY FLUCTUATING FLOW



REPUBLIC pneumatic electric metering system

offers a practical solution to ***DIFFICULT FLOW MEASUREMENTS***

RESTRICTS DANGEROUS FLUIDS . . .
to short lead lines and small measuring chamber in pneumatic transmitter—keeps dangerous or high pressure fluids out of control rooms and mercury-type meter bodies.

CORROSION RESISTANT MATERIALS . . .
can be furnished for measuring chamber to meet requirements of almost any fluid. Corrosive fluids do not come in contact with any other part of meter.

LITTLE MOVEMENT OF LINE FLUID . . .
in lead lines and measuring chamber is required for full range. Dirt is not drawn in to clog meter and cause failure or inaccuracies.

LINE FLUID AND MEASURING CHAMBER AT SAME TEMPERATURE . . .
When measuring hot liquids which are very viscous at room temperature, transmitter may be mounted on flow line to keep temperature of liquid in measuring chamber and flow line the same.

FAST ACTING . . .
meter body does not require large movements of mercury or oil—follows all flow, no matter how erratic or fluctuating.

OTHER ADVANTAGES . . .

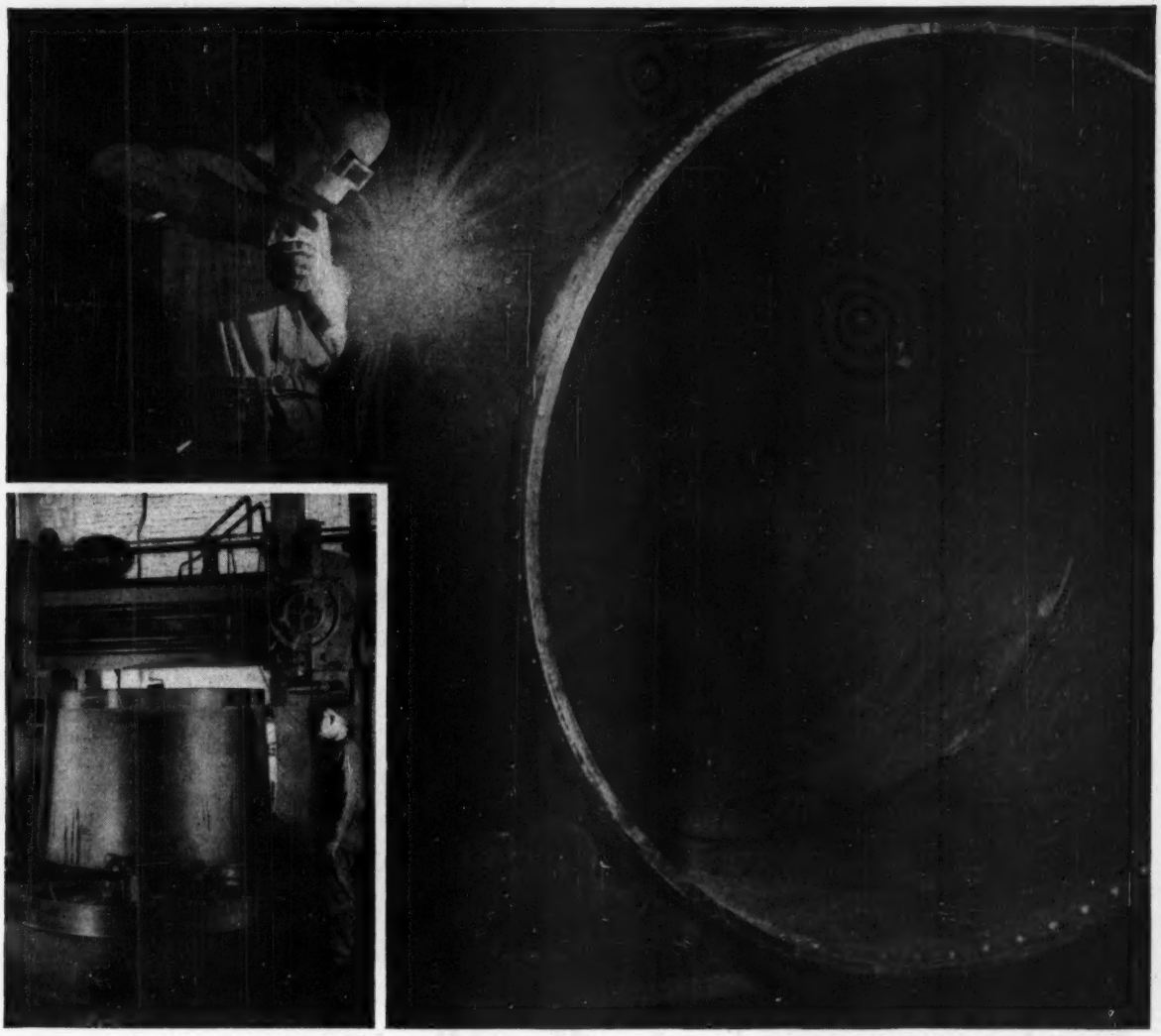
ELECTRIC TRANSMISSION
Flow information can be sent any reasonable distance. Electric meter body extracts square root from flow differential measurement, permitting use of uniformly graduated scales and charts.

CONTINUOUS INTEGRATION . . .
made possible by the exclusive Republic electric integrator aids in accounting and control of expensive fluids.

REMOTE READING INSTRUMENTS . . .
which include recorders, integrators and indicators, can be mounted separately or together, as desired.

WANT MORE INFORMATION?
A new bulletin describing the Pneumatic Electric Flow Meter and its applications is available at no cost or obligation. Send for Bulletin 704.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois



TAPERED small-end Everdur section, before being welded to the large-end tapered section, is machined to fit the throat at C. H. Wheeler Mfg. Co., in Philadelphia.

YOU'RE LOOKING at the throat or intake end of the 2-section, 16-foot-long Venturi outlet cone. This throat is made by roll forming ¾-inch Everdur-1010 plate at The Daniel Russell Boiler Works, Boston, Massachusetts. Here a seam is being welded by the Aircomatic® process. They are using Everdur-1010 Welding Rod.

This Everdur Venturi Tube Meters 350,000 gpm Through New York's Neversink Tunnel

Metering that much water flowing through the new Neversink Tunnel of New York's Delaware Water Supply System at 235 psi static pressure at cone requires an accurately fabricated, strong, corrosion-resistant Venturi outlet cone approximately 16-feet long with an 8-foot diameter tapering to 5 feet, 5 inches at the throat.

Obviously, such equipment, buried in the tunnel, must not fail – and Builders-Providence, Inc., the supplier, had to design to exacting specifications. But costs were also a factor. This huge cone was, therefore, designed for welded fabrication of ⅝-inch thick Everdur*-1010 (ANACONDA Copper-Silicon Alloy) plate.

This outstanding example typifies the virtues of Everdur for fabricating strong, corrosion-resistant equipment by the easy and economical methods to which it so readily lends itself. For, depending on the alloy, you can work Everdur hot or cold, and easily form, forge, weld and machine it. Everdur is available in plates, sheets, rods, tubes, electrical conduit and casting ingots.

Our Technical Department's services are always yours for selecting the best and most practical material for your equipment. *The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

*Reg. U. S. Pat. Off. 53142

EVERDUR

ANACONDA®

COPPER-SILICON ALLOYS

STRONG • WELDABLE • WORKABLE
CORROSION-RESISTANT

Type 316 stainless steel bubble tray column recently built by Pfaudler for Armour & Co.

Assure desired performance at lower cost with Pfaudler Alloy Towers

Whatever your requirements for fractionating or stripping columns, for bleaching or absorption towers; Pfaudler is prepared to meet them at the *lowest possible cost* to you.

CUSTOM DESIGN

If you have your own design group, we can meet your most exacting specifications. Or, we will be glad to undertake the complete process engineering—or any phase of it including bubble tray layout—as well as equipment design to meet your *desired end product requirements.*

WIDE RANGE OF ALLOYS

To assure maximum service life for your equipment, Pfaudler offers a *complete* range of corrosion resistant materials. It includes stainless steel, hastelloy, monel, nickel, inconel, aluminum, carbon steel and clad materials. And to meet special corrosion problems at low cost, Pfaudler is prepared to heat treat stainless steel equipment in automatically controlled furnaces.

PROCESS KNOW-HOW

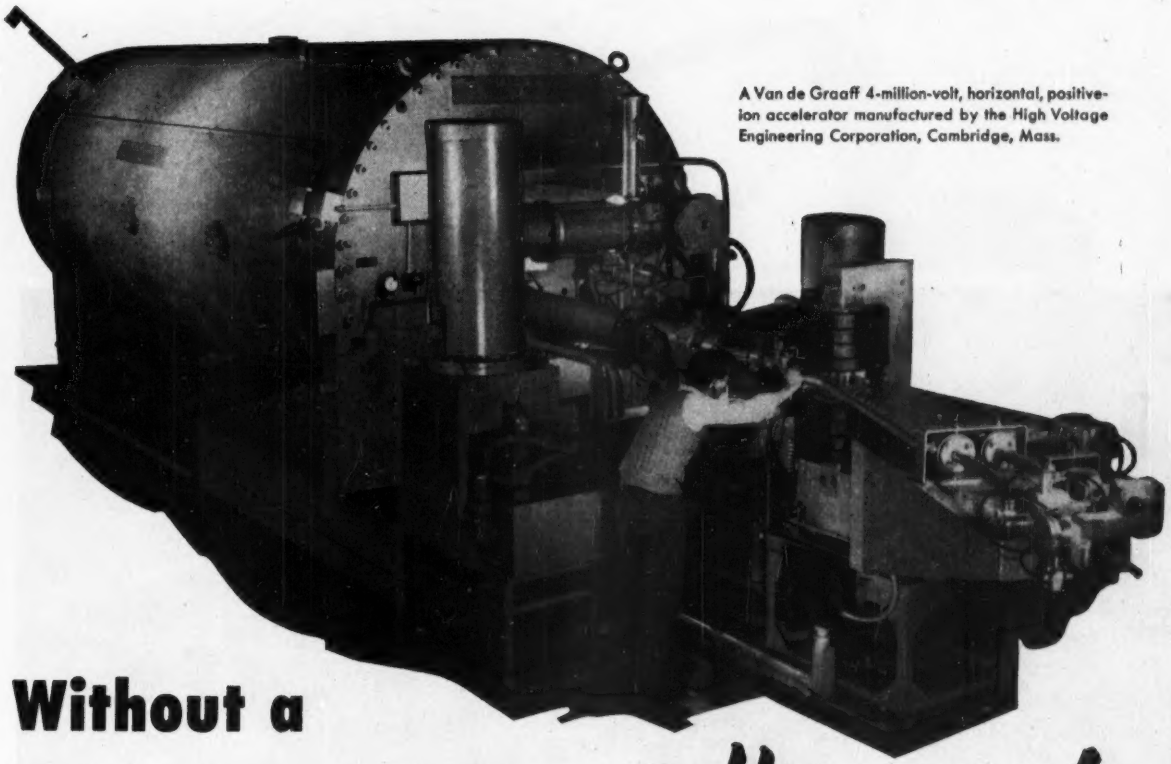
From years of specialized contact with such basic industries as chemicals, pharmaceuticals, petrochemicals, food, dairy, beverage, and others, Pfaudler engineers are able to keep pace with improvements in *all* the process industries... and translate this broad experience into economical, soundly-engineered recommendations for *your* process equipment.

Write today for full details on the complete Pfaudler line of chemical processing equipment.

Pfaudler

THE PFAUDLER CO.
ROCHESTER 3, N. Y.
Engineers and fabricators of corrosion resistant process equipment

GLASS-LINED STEEL • HASTELLOY • ALUMINUM • CARBON STEEL • SOLID OR CLAD STAINLESS STEEL • NICKEL • INCONEL • MONEL



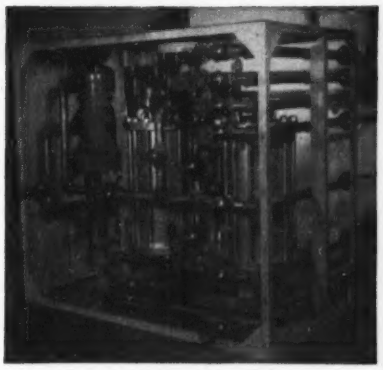
A Van de Graaff 4-million-volt, horizontal, positive-ion accelerator manufactured by the High Voltage Engineering Corporation, Cambridge, Mass.

Without a DRY gas insulation, *Whammo!*

A 4-million-volt streak of lightning would arc through normal humid air or gases, strike against the metal shell of this Van de Graaff electrostatic atom smasher and cause trouble.

A BAC-150 Lectrodryer* eliminates this danger by DRYing insulating nitrogen and carbon dioxide gases to a dewpoint of −100°F . . . or lower, and KEEPS THEM DRY!

Lectrodryers are providing DRYness like this to air, gases or organic liquids in many industries where unwanted moisture has been found troublesome. Perhaps in our files right now there's a case similar to yours which Lectrodryer has solved successfully. Our engineers would like to discuss any moisture problem with you. Write: Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.



Type BAC-150 Lectrodryer used by the High Voltage Engineering Corp. for DRYing insulating gases charged into high-voltage atom smashers.

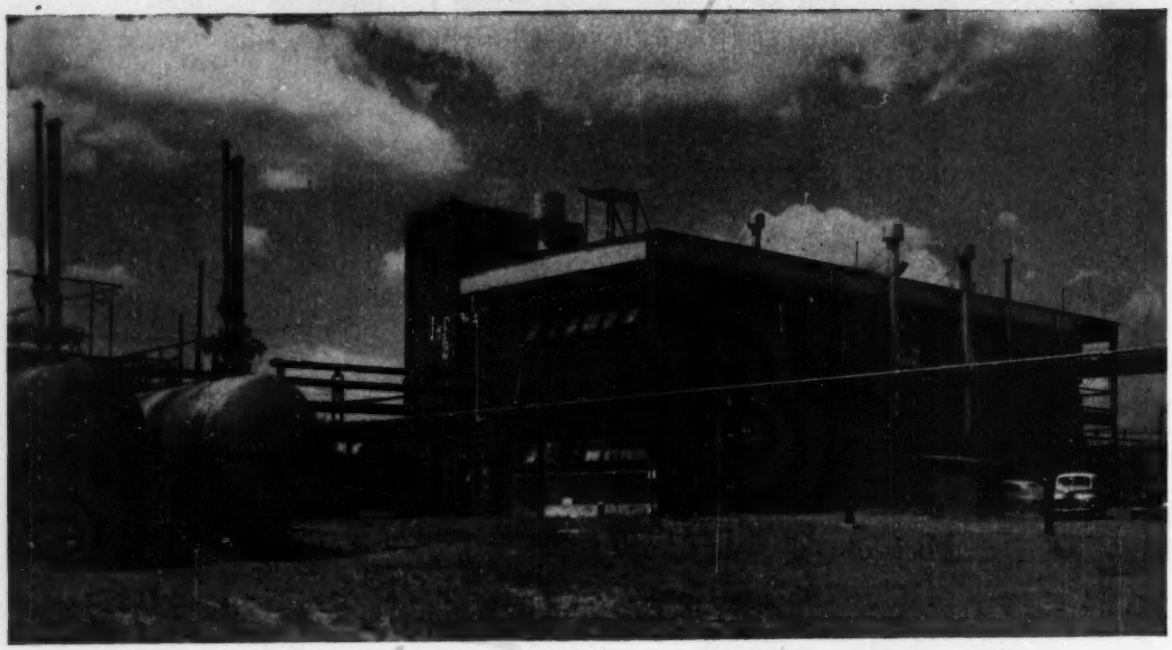
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U.S. PAT. OFF.

Oh, I see



. . . they're using

our valves at

GOODYEAR

The Goodyear Chemigum Plant at Akron relies on perfect valve functioning . . . precise flow control with valves that are dependable, just as you may. Their choice throughout this plant is OIC.

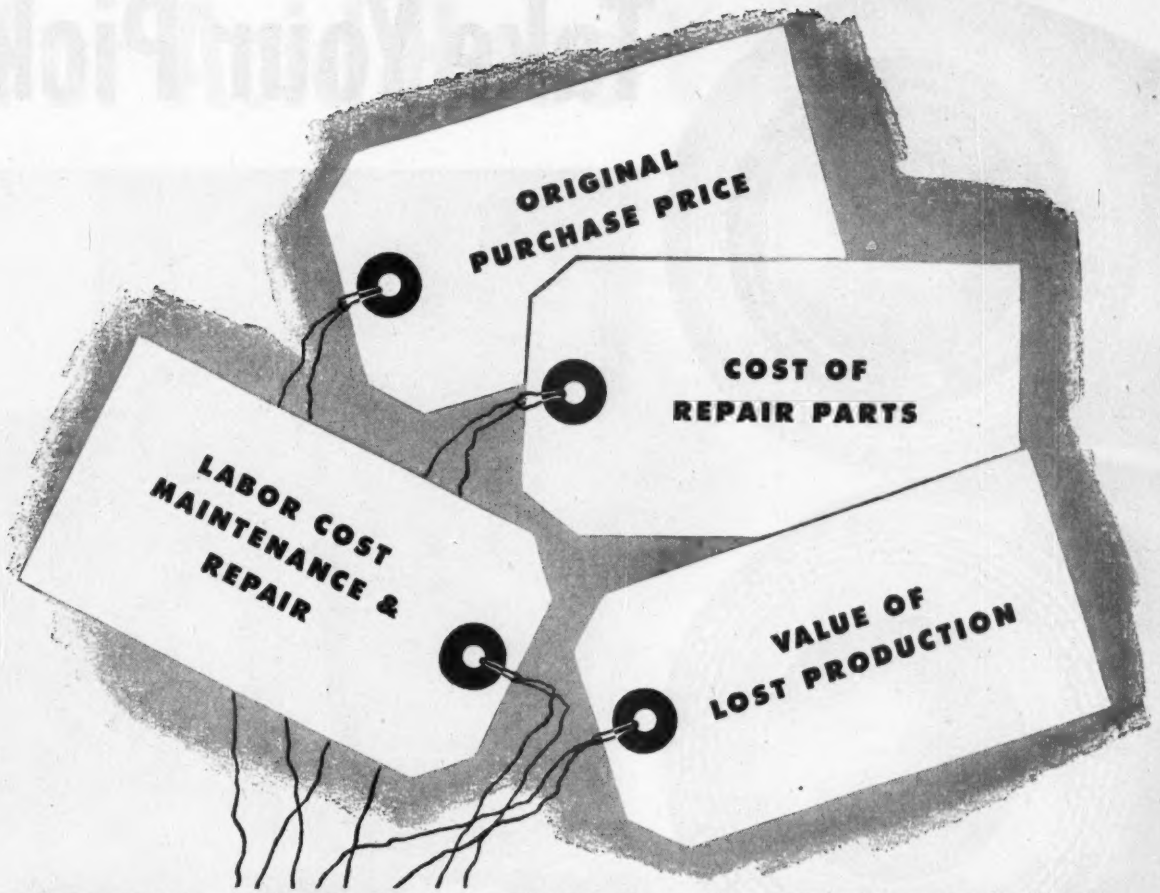
You pay no extras for OIC's precision engineering, even though you do get longer, trouble-free valve service. In addition, OIC offers you engineering assistance to help you select valves best suited for the job.

If you could see them made, you'd make OIC Valves your first choice when you want dependability.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC FOUNDED 1893

VALVES | FORGED & CAST STEEL, IRON & BRONZE, LUBRICATED PLUG VALVES



HOW MANY PRICE TAGS ON A CHEMICAL PUMP?

The important factor in determining the value of a chemical pump is its life cost. First cost or purchase price is just the beginning. How often is the original cost duplicated in cost of repairs? In maintenance, lubrication, repacking and adjustments? In lost production due to pump failure?

It is no accident that LaBour pumps, over the years, have piled up enviable records for low life costs and for continuity of operation. LaBour has always specialized in the manufacture of equipment for handling corrosive liquids; LaBour pumps are not merely adaptations of hydraulic pumps, fabricated from corrosion resistant materials.

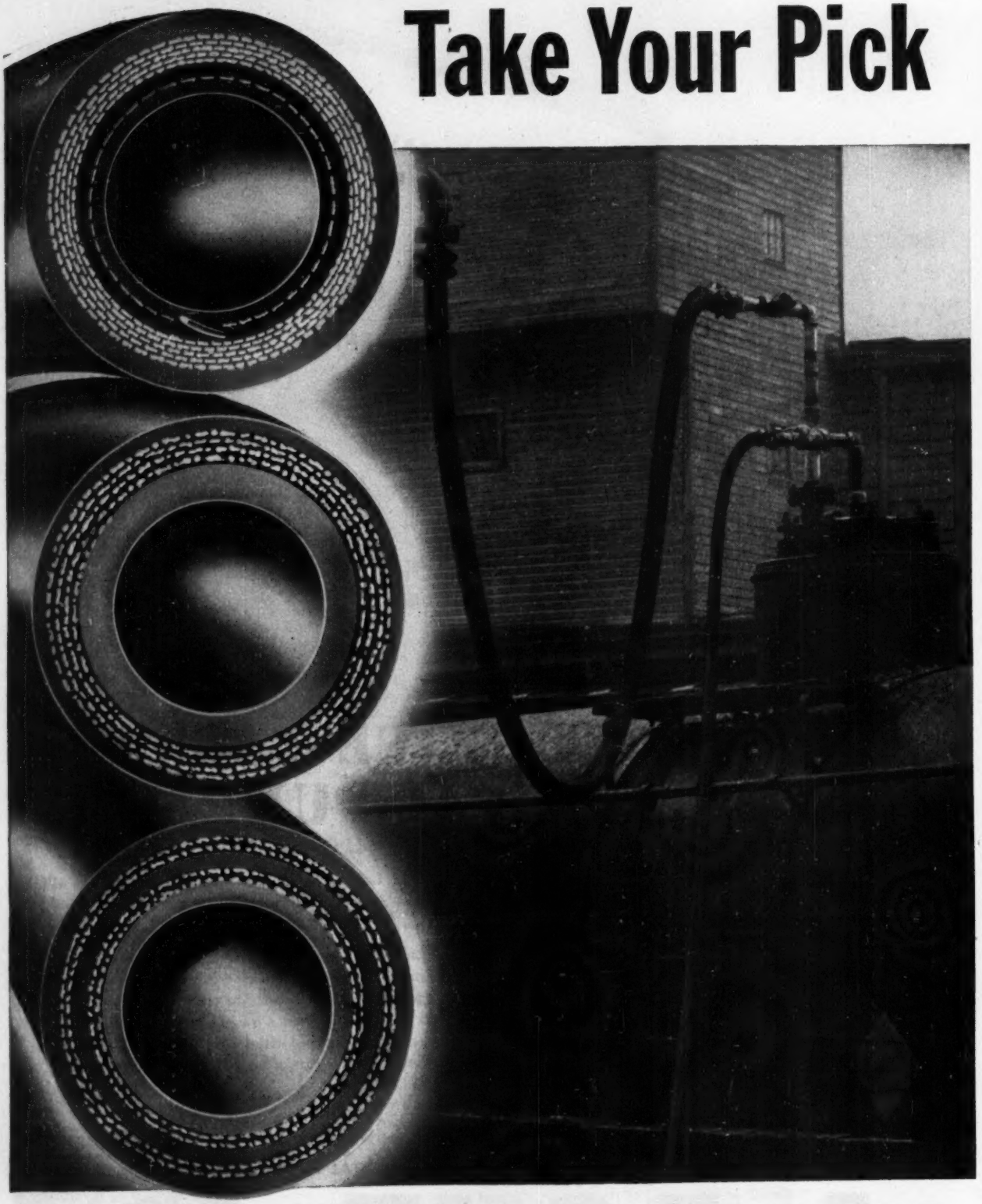
LaBour pumps are designed and built especially for chemical service. Years of experience in chemical applications have given LaBour an unequalled background out of which has come a variety of types to meet the specific pumping need with the right pump for that job. That is another reason for the service records established by LaBour.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.

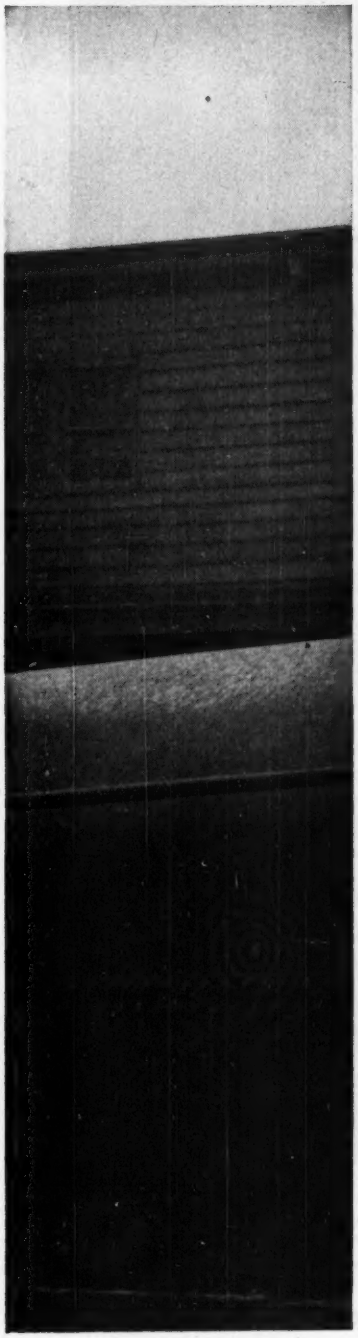
Take Your Pick



HEWITT-ROBINS

EXECUTIVE OFFICES, STAMFORD, CONNECTICUT

For Acid Hose Value



Whether your problem is conductance of acids and chemicals under pressure, syphoning or suction or controlled flow . . . Hewitt Monarch Acid Hose is designed to give longer life at a minimum cost.

Here's proof: "Monarch® Acid Hose, handling bright nickel solution, the basic acid of which is Sulphuric Acid (*p*H2.5-3.0) has held up for five years." . . . "Monarch 2" 4-ply Acid Hose, in service approximately 2½ years has handled over 36 million gallons of Chlorate." . . . "Monarch Acid Hose, after 4½ years and handling over 50 million gallons of chlorine, still in service."

ENGINEERING DATA

TUBE: Pure gum rubber specially compounded to resist most acids and alkalies up to 50% concentration at temperatures up to 150°F . . . safely handles many acids at any concentrations.

REINFORCEMENT: Acid Conducting Hose—multiple plies of high-tensile cotton duck with insulating cushion of rubber between plies for increased flexibility.

ACID PINCH-VALVE HOSE—two separate reinforcing walls of high-tensile cotton duck insulated from each other by a thick layer of pure gum rubber, provides maximum flexibility, assures greatest service life by eliminating crushing of duck by pinch bars when controlling flow.

ACID SUCTION HOSE—a helix of round spring wire between multiple plies of high-tensile duck provides resistance to suction forces . . . flexible, easy to handle.

COVER: Pure gum rubber designed to resist acids, alkalies and chemicals. Tough, to resist abrasion and cutting.

SIZES: All types available in ¾" to 12" I.D. and in tube thickness ⅛", 3/16" and ¼".

CHECK FOR INFORMATION ABOUT THESE JOB-TESTED PRODUCTS FOR YOUR OPERATION

CONVEYORS:
- ☐ —Belt
- ☐ —Sectional
- ☐ —Vibrating

BELTING:
- *☐ —Elevator
- *☐ —General Conveyor
- *☐ —Hot Materials
- *☐ —Rayon
- ☐ —Woven Wire

☐ BUCKET ELEVATORS
☐ IDLERS

SCREEN CLOTH:
- ☐ —Electrically Heated
- ☐ —General

VIBRATING SCREENS:
- ☐ —Dewaterizers
- ☐ —General
- ☐ —Hydrex®
- ☐ —Slip Lawn

HOSE:
- *☐ —Acid
- *☐ —Air
- *☐ —Fire
- *☐ —Flexible Rubber Pipe
- *☐ —Pinch-Valve
- *☐ —Servall®
- *☐ —Steam
- *☐ —Twin-Weld®
- *☐ —Water

☐ MECHANICAL FEEDERS
☐ STACKERS
☐ CAR SHAKEOUTS
☐ TRIPPERS
*☐ MOLDED RUBBER GOODS
☐ DESIGN AND CONSTRUCTION OF COMPLETE MATERIALS HANDLING SYSTEMS

*For immediate information about these industrial rubber products, call your Hewitt Rubber Distributor (See "Rubber Products" Classified Phone Book.)

Hewitt-Robins Incorporated
666 Glenbrook Road
Stamford, Connecticut

NAME

TITLE & COMPANY

STREET ADDRESS

CITY PO ZONE STATE

1033

INCORPORATED

DOMESTIC DIVISIONS: Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam
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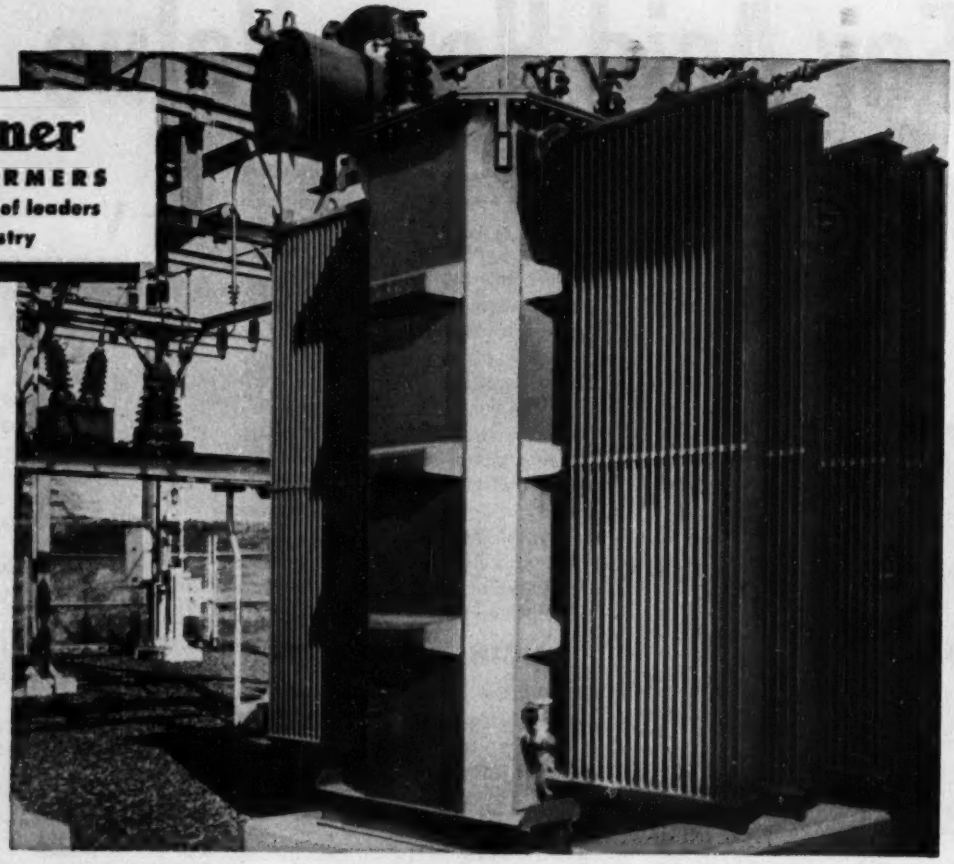
Wagner
TRANSFORMERS
... the choice of leaders in industry



to help make good foods better...

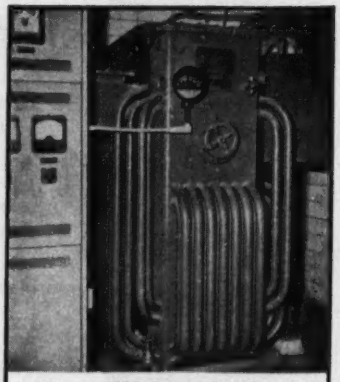
The Vitamin Division of Hoffmann-LaRoche, Inc., at Nutley, New Jersey helps food processors "keep faith with nature." It produces ascorbic acid that protects processed foods from loss of natural color and flavor and adds to their nutritional value. It produces vitamins for the enrichment of bread, cereals, and other grain foods.

The Hoffmann-LaRoche plant—like all modern industrial plants—depends on electricity as its source of power for production. Wagner transformers play an important part in powering production at Hoffmann-LaRoche.

The 4000 kva Wagner Power Transformer, shown above, supplies the power for the plant. Five additional Wagner distribution and substation transformers, rated from 100 to 500 kva, distribute power at the right voltage for use at various load centers throughout the plant.

Wherever electric power is used—in industry, commerce, city and farm—Wagner Transformers efficiently and dependably handle their unending job of supplying proper voltages for every purpose.

A Wagner engineer can help you select the right transformers for *your* requirements. Consult the nearest of our 32 branch offices, or write us.



Wagner 500 kva Noflamol Unit Substation Transformer installed at Nutley, New Jersey plant of Hoffmann-LaRoche, Inc.

Wagner Electric Corporation
EST. 1891

WAGNER ELECTRIC CORPORATION
6407 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS – AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

T33-8

For uniform purity in every shipment... specify HYSTRENE® fatty acids

PURITY:

Hystrene hydrogenated fatty acids are exceptionally pure . . . have lower percentages of unsaponifiables and unsaturates than other fatty acids.

UNIFORMITY:

strict control over manufacturing methods provides complete uniformity from shipment to shipment . . . from bag to bag.

COLOR STABILITY:

in every color test—heat exposure, potassium soap, sulfuric acid—you'll find that Hystrene has greater stability. This more stable color often eliminates the need for bleaching, distilling, and other color-improving processes in your manufacturing operations.

Whichever Hystrene type you use . . . Hystrene S-97 hydrogenated soya fatty acid, or Hystrene T-70 hydrogenated tallow fatty acid . . . you'll get the utmost in quality every time. For complete technical details, write or call Atlas today.

HYSTRENE SPECIFICATIONS

	HYSTRENE T-70	HYSTRENE S-97
Titer (Average °C.)	61.5-62.5	65.5-66.5
Iodine Value (Wijs)	0.5 Max.	0.8 Max.
Unsaponifiables (%)	0.15 Max.	0.25 Max.
Color (Lovibond, 5¼" Cell)	2Y-0.4R Max.	3Y-0.7R Max.
Free Fatty Acid (as stearic—%)	100.5-102.5	100.0-101
Acid No. (Average)	198-202	196-200
Saponification No. (Average)	199-203	198-201

INDUSTRIAL CHEMICALS DEPARTMENT

ATLAS POWDER COMPANY

WILMINGTON 99, DELAWARE

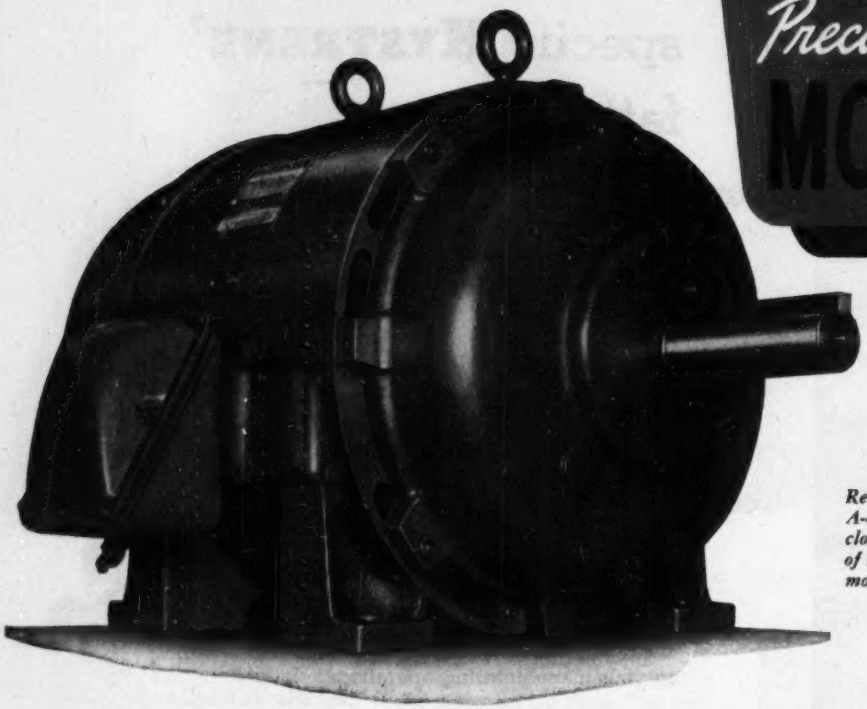
offices in principal cities

ATLAS POWDER COMPANY, CANADA, LTD. BRANTFORD, CANADA

FOR RUGGED SERVICE...

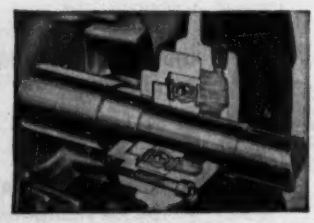
"All motors are NOT alike!"

RELIANCE
Precision-Built
MOTORS



Reliance Totally-enclosed Fan-cooled A-c. Motor. All other standard enclosures available, with wide choice of mechanical designs and special mountings. Ratings from 3/4 to 300 hp.

- ☆ Heavy shafts, bearing to bearing
- ☆ Indestructible pressure-cast rotors
- ☆ Shock-resistant frame and bearing-bracket construction

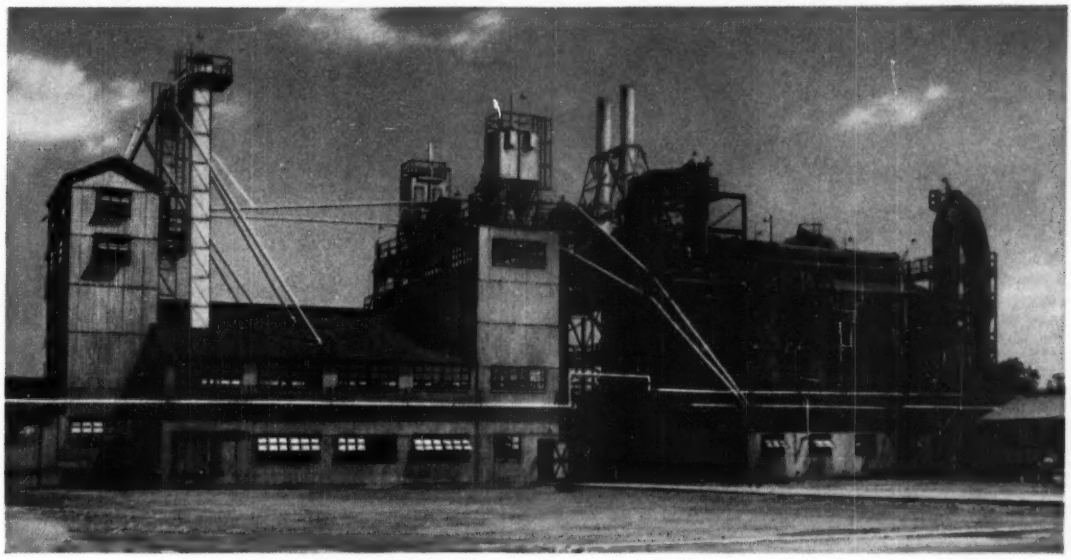


. . . AND THE BEST PRE-LUBRICATED BEARING DESIGN

The Reliance pre-lubricated bearing provides *four times more operating hours without re-lubrication* than any other bearing used in motors today. And—whatever your lubrication schedule—*you just can't grease 'em wrong!* To get the complete "inside story" on motor bearings, write today for Bulletin B-2201. It contains hard facts on the advantages of the Reliance pre-lubricated bearing design, with cutaway view, cross-section diagram, comparison chart, and statements by bearing manufacturers. B-1458 J

RELIANCE ELECTRIC AND ENGINEERING CO.

1063 Ivanhoe Road, Cleveland 10, Ohio • Sales Representatives in Principal Cities



NEW INDUSTRY *for Canada*

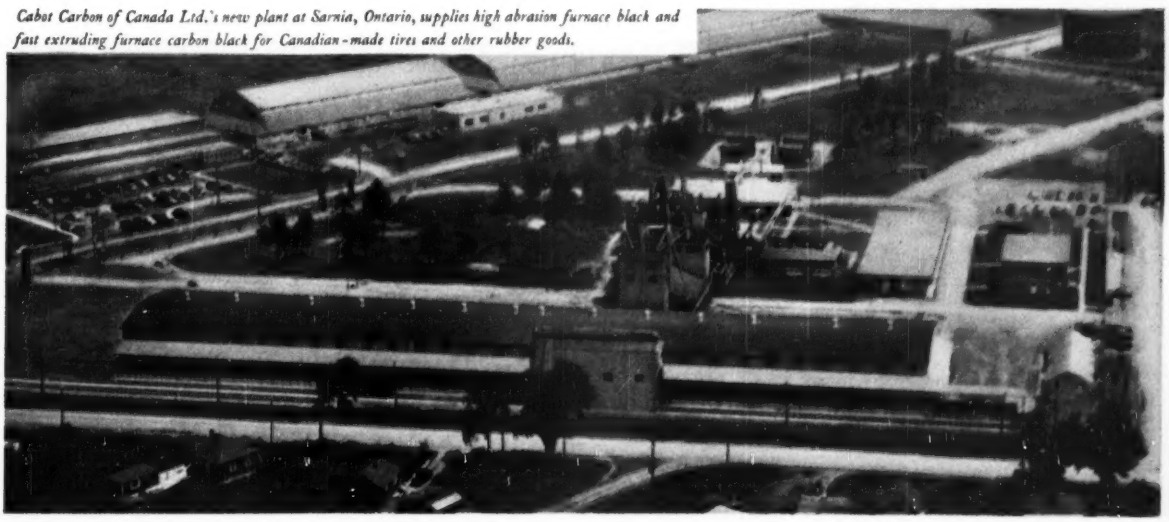
The Furnace Carbon Black plant of Cabot Carbon of Canada Ltd. is Canada's first oil furnace carbon black plant.

The principal process equipment was designed by Cabot Engineering Company of Pampa, Texas, affiliates of Cabot Carbon of Canada, Ltd. Stone & Webster Canada Limited, with the assistance of Stone & Webster Engineering Corporation, furnished consulting services and constructed the plant.

STONE & WEBSTER ENGINEERING CORPORATION

Affiliated with **STONE & WEBSTER CANADA LIMITED**

Cabot Carbon of Canada Ltd.'s new plant at Sarnia, Ontario, supplies high abrasion furnace black and fast extruding furnace carbon black for Canadian-made tires and other rubber goods.



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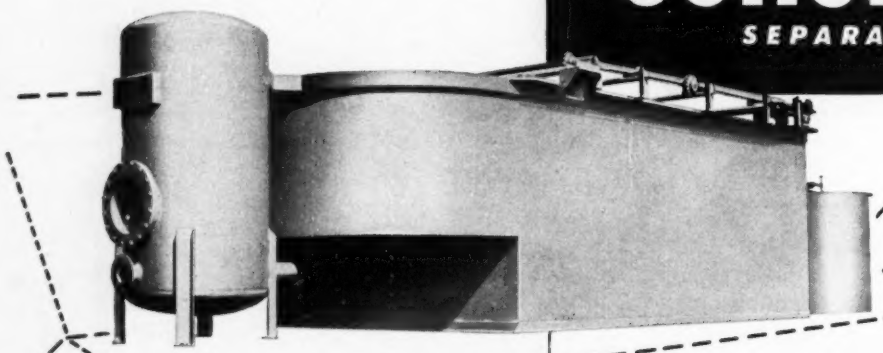
INDUSTRIAL WASTE WATER TREATMENT

to meet pollution regulations

BULKLEY-DUNTON

colloidair

SEPARATORS



720,000 G.P.D. COLLOIDAIR for prefabricated delivery

Installations are also designed and supplied on a "turn-key" basis

Meets government specifications for aircraft maintenance wastes treatment facilities

This equipment meets state, regional, and local disposal requirements with...

HIGH EFFICIENCIES • LOW SPACE REQUIREMENTS • PROVEN PERFORMANCE

Write for details today!

BULKLEY-DUNTON PROCESSES, INC.

Dept. P-1, 295 Madison Ave., New York 17, N. Y.

Pacific Coast: Dept. P-1, Security Bldg., Pasadena, Calif.

What tube steel gives you the best life/cost ratio? Ask the experts!

This month's report is on: **2% CR.-MO.**

Has intermediate corrosion resistance in combination with good creep strength and fair resistance to oxidation. For use at temperatures up to 1200° F. in cracking coils, reforming units, heat exchangers, vapor line and hot oil piping, and return-bend forgings for oil heaters.

23 TIMKEN® STEELS FOR HIGH TEMPERATURE SERVICE

Carbon	Sicromo 2	Sicromo 5S	16-13-3*
Carbon-Mo.	Sicromo 2½	Sicromo 5MS	25-20*
DM-2	2¼% Cr.-1% Mo.	Sicromo 7	25-12*
Silmo	Sicromo 3	Sicromo 9M	35-15*
DM	4-6% Cr.-Mo.	18-8 Stainless	16-25-6*
2% Cr.-Mo.	4-6% Cr.-Mo.-Ti.	18-8 Cb	

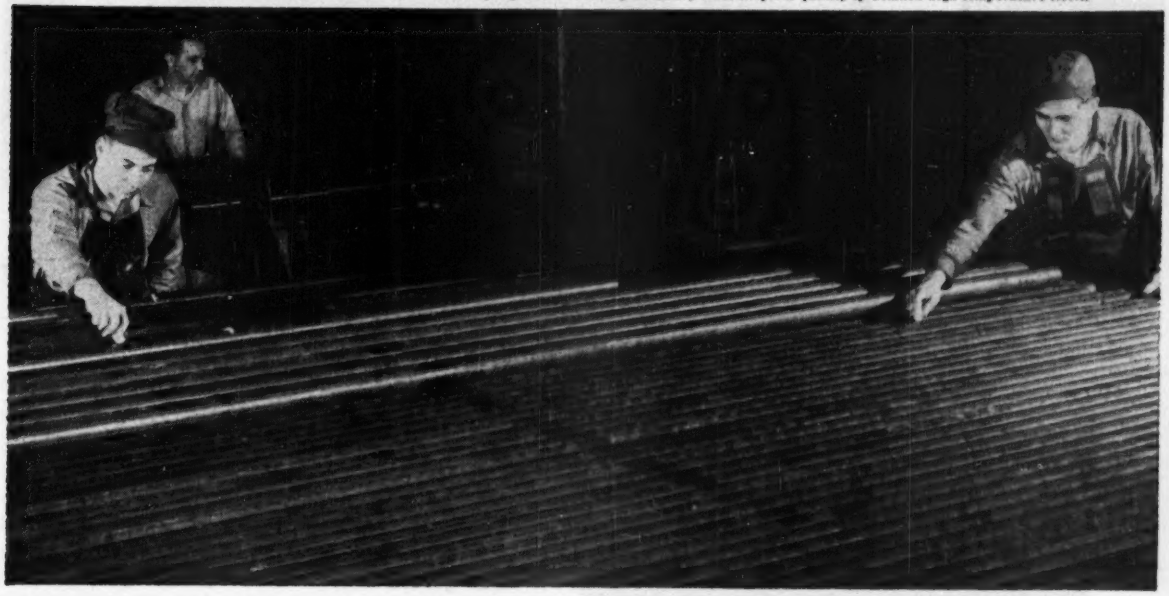
*Not available as seamless tubing at the present time.

MAYBE you can find several high temperature tube steels that will solve your particular set of heat, pressure, corrosion and oxidation problems. But there's only *one* steel that will give you maximum tube life per dollar—the best life/cost ratio.

To find that one steel, go to the metallurgists of The Timken Roller Bearing Company. They're recognized authorities on high temperature steels. Backed by 20 years' experience and research and with 23 different analyses at their disposal, they'll help you choose the one best steel for your application. And you'll be assured of uniform quality in every tube because of the Timken Company's rigid quality control from melt shop through final inspection.

Our "RSQ"—Research, Supply, Quality—can solve your tube problems. *Ask the experts!* The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

Photo below shows final tube inspection—last of hundreds of rigid tests that help account for the uniform quality of Timken high temperature steels.



YEARS AHEAD—THROUGH EXPERIENCE AND RESEARCH

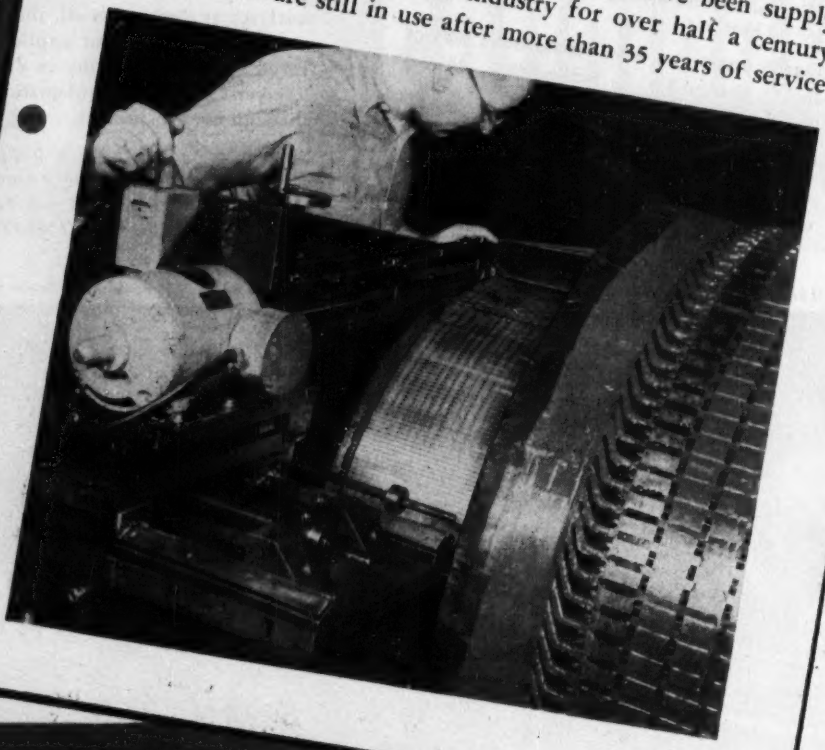
SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

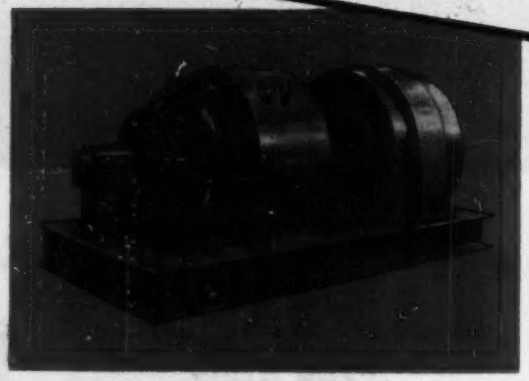
ANOTHER* EXAMPLE OF ELLIOTT Excellence

*Precision Workmanship

in the careful undercutting of commutator mica segments, is characteristic of the painstaking attention to detail which insures dependable performance in Elliott large direct-current motors and generators.

This extreme care in all stages of design and manufacture, is traditional in Elliott machines. Elliott shops have been supplying direct-current machines to industry for over half a century. Some of them are still in use after more than 35 years of service.





At left is shown an Elliott 500-kw, 900-rpm motor-generator set, driven by 750-hp synchronous motor.

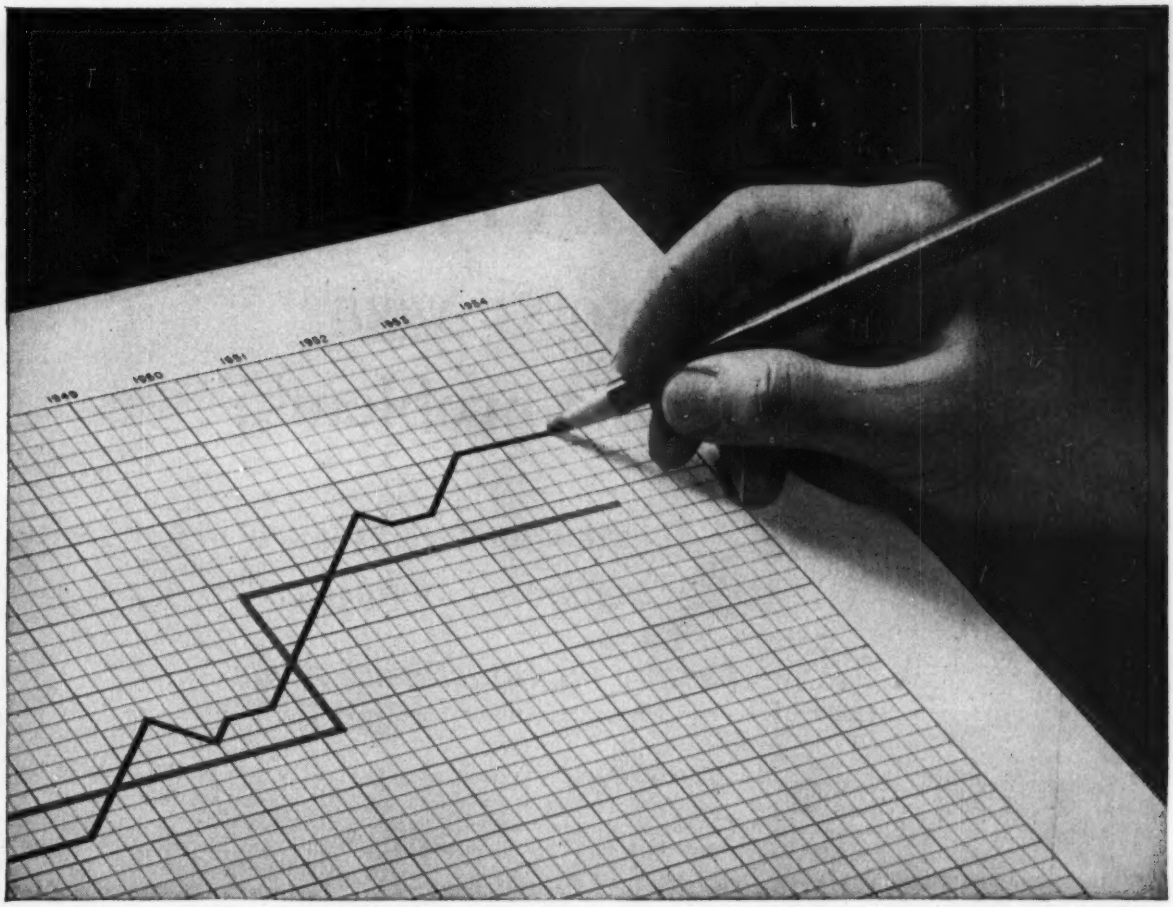
For full details on Elliott Fabri-Steel motors and generators, call your local Elliott representative or write the Elliott Company, Ridgway, Pa.

Elliott FABRI-STEEL MOTORS AND GENERATORS R3-13

ELLIOTT Company

RIDGWAY DIVISION

FOR MOTORS 1-200 HP: CROCKER WHEELER DIV. AMPERE, N. J.



Caution: dangerous curves

Keeping your fire protection properly balanced with changes in processes as well as ups and downs in production is vital to efficient, profitable operation.

You'll find your best answer to this serious fire problem which is currently confronting industry by installing an expansible, fully approved C-O-TWO Low Pressure Carbon Dioxide Type Fire Extinguishing System. Simple piping, running from one centrally located storage tank, instantly transports clean, non-damaging, non-conducting carbon dioxide anywhere in the plant area. Fire at any protected location is extinguished in seconds with an absolute minimum of expense and interruption.

Changes in your fire protection requirements are easily and economically provided for with a C-O-TWO Low Pressure Carbon Dioxide Type Fire Extinguishing System by initially installing an oversized storage tank and adding where necessary the supplementary discharge facilities at a later date.

Flexibility is the keynote . . . the low pressure carbon dioxide storage tanks range in capacity from one to fifty tons . . . discharge facilities can be either manual mechanical, manual electric, automatic mechanical, automatic electric or a combination of these . . . especially installed to fit your particular needs.

WHEN BUSINESS STOPS . . . INCOME STOPS!

Don't take chances with your investment. Secure the benefits of highly efficient fire protection engineering today... our extensive experience over the years is at your disposal without obligation. Get the facts now!

C-O-TWO

MANUFACTURERS OF APPROVED FIRE PROTECTION EQUIPMENT

Squeez-Grip Carbon Dioxide Type Fire Extinguishers
Dry Chemical Type Fire Extinguishers
Built-In High Pressure and Low Pressure Carbon Dioxide Type Fire Extinguishing Systems
Built-In Smoke and Heat Fire Detecting Systems

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1 • NEW JERSEY

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Sales and Service in the Principal Cities of United States and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

Which of these BASIC MATERIALS will solve *your* processing problems?

Norton Relectric furnace products are engineered and prescribed to meet many manufacturing needs

Backed by over 50 years of experience in electrochemical refining, Norton brings you basic materials whose purity and properties are carefully controlled and consistently duplicated.

These Norton electric furnace products differ greatly in composition and characteristics. They are the source of the many Norton *engineered prescriptions* which have proved of immense practical value in widely varying processes.

Moreover, each of them has possibilities for use which are still undiscovered. It will pay you, therefore, to read the following descriptions very carefully. Even this partial list may contain the exact combinations of properties *you* need.

ALUMINUM OXIDE (ALUNDUM®)

Norton is the world's largest producer of this basic material — fused alumina. *Characteristics:* high melting point, about 3700°F; specific gravity, 3.95; good chemical stability, neutral to most chemical reagents; extreme hardness of 2000 Knoop, with great toughness; reasonably high thermal conductivity, 9½ times that of fire clay; high dielectric strength. *Uses:* heavy refractory furnace shapes; pure oxide and sintered refractories; radio tube insulation; porous media for filtration and diffusion; catalyst carriers and fluid catalysts; heat exchange pebbles; wear-resistant parts; laboratory ware.

SILICON CARBIDE (CRYSTOLON®)

Silicon carbide is produced by Norton in large tonnages. *Characteristics:* high melting point, disassociates at about 4175°F; specific gravity, 3.20; extreme hardness of 2500 Knoop, with excellent abrasion and erosion resistance; high thermal conductivity, 7 to 10 times that of fire clay; excellent resistance to thermal shock; maintains great strength to very high temperatures (PCE, 3350°F — cone 37 to 40); unique electrical qualities; relatively low thermal expansion; no inversion on heating; chemically acidic, with good stability. *Uses:* special refractories for boiler furnaces, ceramic kiln furniture, heat treating, hearth plates, high thermal conductivity muffles and retorts; electrical heating elements; lightning arrestors; metallurgical additions; also available in a Norton-patented process for coating graphite — in rocket nozzles and reaction motor parts, etc. — for increased resistance to erosion by high velocity gases.

MAGNESIUM OXIDE (MAGNORITE®)

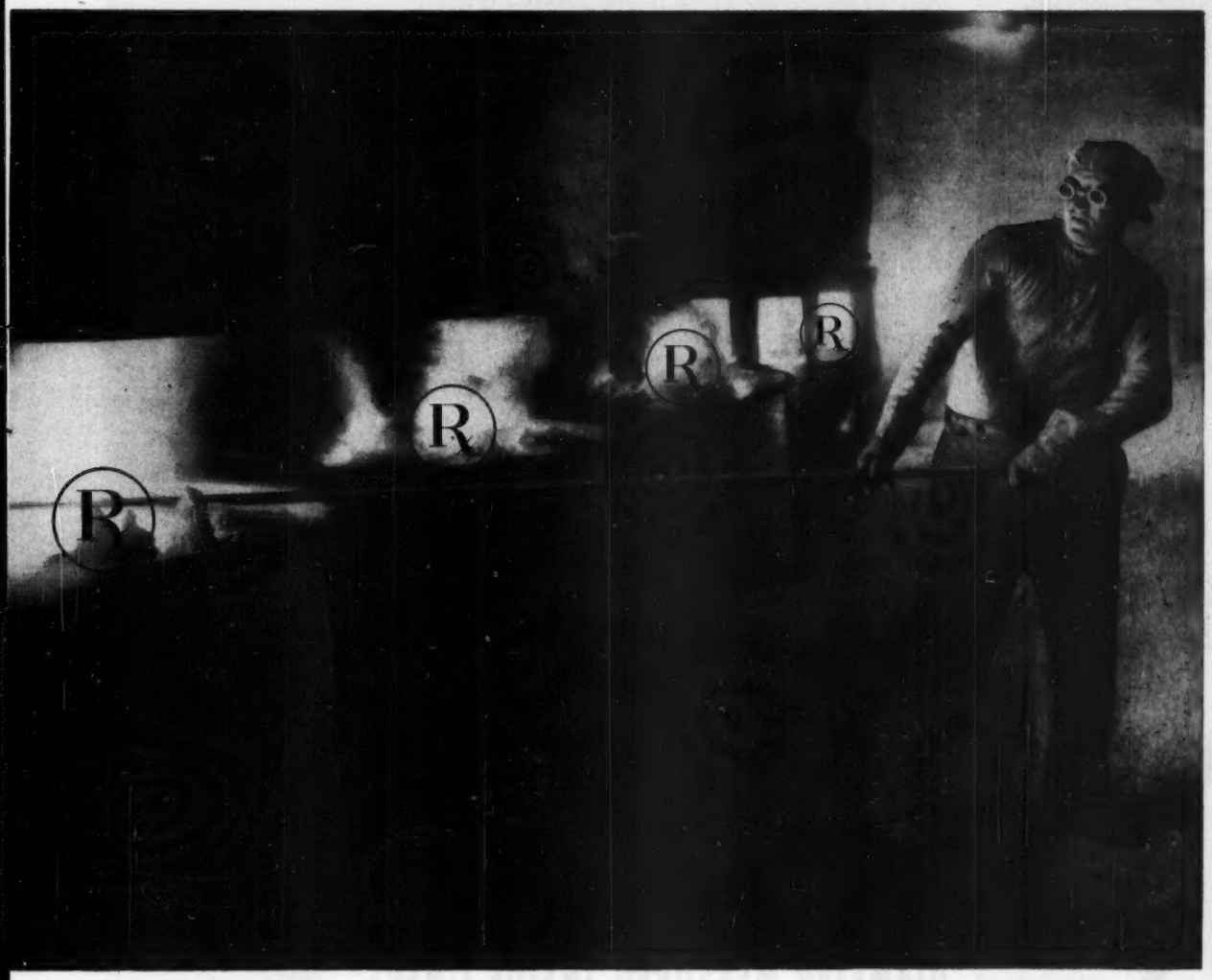
Fused magnesia of highest purity. *Characteristics:* extremely high melting point, about 5,000°F; specific gravity, 3.58; electrical resistivity, 10^8 ohm cm at 1000°C; chemically basic. *Uses:* linings for metal melting furnaces; high temperature electrical insulation; refractories for handling corrosive caustic materials.

FUSED STABILIZED ZIRCONIA

Norton was the first to develop fused zirconia for practical commercial use. *Characteristics:* high melting point; thermal conductivity in British Units at 2000°F is 6.2 for dense shapes, 4.7 for insulating shapes, 2.8 for insulating grain; high resistance to abrasion and thermal shock; not wet by most molten metals; changes from a fairly good electrical insulator at low temperature to a conductor at 1000°C. *Uses:* refractories for extremely high temperatures; setter plates for titanates; furnace linings for high temperature gaseous chemical reactions; zirconium chemicals; metal melting furnace linings; catalyst carriers; heat exchange pebbles; reaction engine parts including jet and rocket liners.

BORON CARBIDE (NORBIDE®)

The hardest man-made material, an exclusive Norton development of boron carbide. *Characteristics:* high melting point, 4440°F; specific gravity, 2.50; compressive strength, 414,000 psi; bending strength, 44,000 psi; self-bonding, unaffected by all acid and alkali solutions. *Uses:* abrasive for economical replacement of diamond dust in lapping; high purity powder of micron sizings for use as refractory and in "cermet" combinations; neutron absorption in nuclear reactors or particle accelerators; pressure-blast nozzles; wearproof bushings, slides, etc.



In these Higgins type arc furnaces tremendous amounts of electrical energy are utilized by Norton in electrochemically refining crude minerals into basic Rx refractory materials.

BORON NITRIDE

Refined by Norton to over 98% purity. *Characteristics:* melts or dissociates at 5400°F; a nonconductor of electricity; weighs only 7 lbs. per cu. ft.; is not oxidized in air at 1200°F. *Uses:* anti-sticking agent for use with molten glass or metal; heat-resistant lubricant; thermal insulator in vacuum or atmosphere furnaces; experimental refractory or crucible material; experimental electrical insulator.

MANY OTHER MATERIALS

Among the high-melting, useful materials made available by Norton are Special Fused Oxides, Refractory Carbides, Refractory Borides, Mixed Borides, Elemental Boron. Research, development and field testing are being conducted on Experimental Borides, Carbides, Nitrides and Silicides. Some of these are in regular industrial use and new uses are being found for others.

AVAILABLE IN MANY STANDARD OR SPECIAL FORMS

Besides supplying these materials in their crude form, more or less as they come from the furnace, Norton has extensive facilities for processing and fabricating — and is ready to work with you in engineering any of these materials to your particular requirements.

GET THIS BASIC MATERIALS BOOKLET

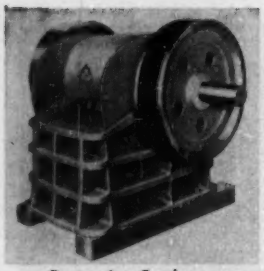
This new Norton Publication, "Basic Materials," contains 22 pages of detailed information, including actual and suggested uses. For your copy, write to NORTON COMPANY, 511 New Bond St., Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

NORTON

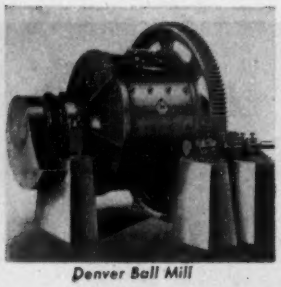
Rx REFRACTORIES

Making better products . . . to make other products better

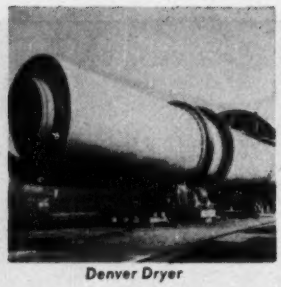
*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries



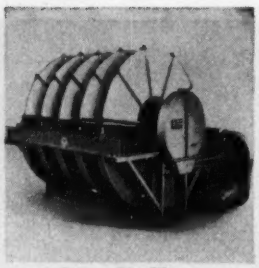
Denver Jaw Crusher



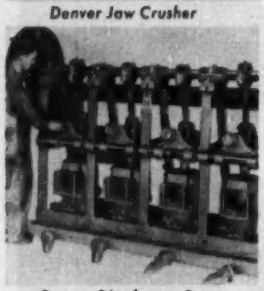
Denver Ball Mill



Denver Dryer

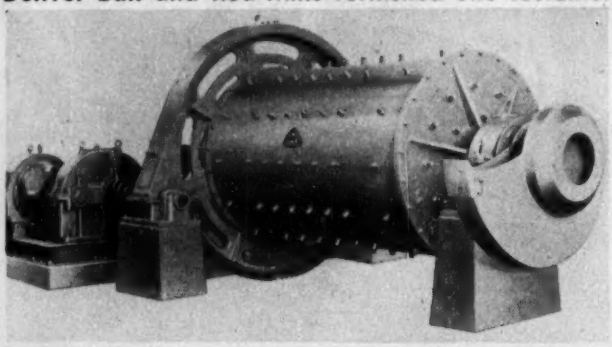


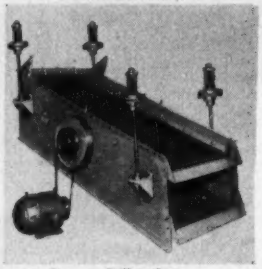
Denver Disc Filter



Denver Diaphragm Pump

5' x 10' Denver Steel-Head Rod Mill... one of 21 Denver Ball and Rod Mills furnished one customer





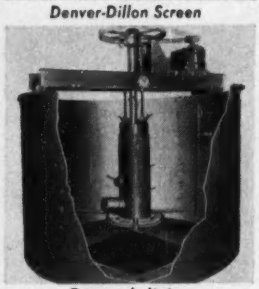
Denver-Dillon Screen

Denver Classifier

DENVER STEEL-HEAD BALL-ROD MILLS

4-times greater strength than cast iron!

Denver Ball and Rod Mills are made with cast-steel heads integral with trunnions, giving 4-times greater tensile strength than cast iron. Steel-head design permits a choice in type of construction... heads may be welded to the rolled steel shell or bolted to a steel flange welded to shell. Sizes: 30" x 18" to 6' x 24'.

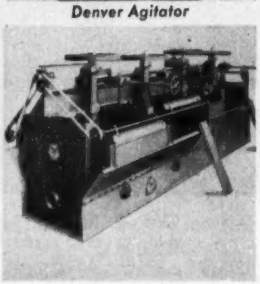


Denver Agitator

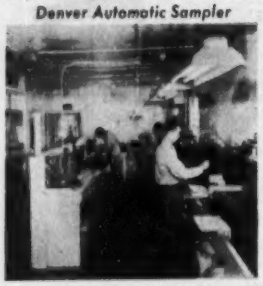
Denver Automatic Sampler

DIAMETER MEASURED INSIDE LINERS

Diameter of the Denver Steel-Head Ball-Rod Mills is measured inside liners... giving up to 28% greater capacity than mills with liners measured inside shell.



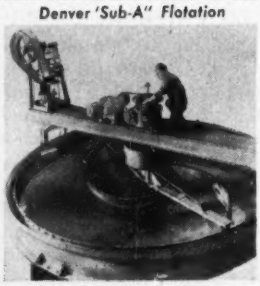
Denver 'Sub-A" Flotation



Denver Testing Service

FLEXIBILITY WITH STANDARDIZED DESIGN

With the standard Denver mills you have a choice of several types of feeders, discharges, trunnions, and drives... a combination may be selected to fit your particular problem, without the high cost of specially built mills. You can depend upon obtaining "Standard-Reliable-Efficient" performance with Denver Steel-Head Ball-Rod Mills... write, now, to any of the conveniently located Deco offices, for Bulletin B2-B13.



Denver Hydroclassifier

"The firm that makes its friends happier, healthier and wealthier"

DECO FLOTATION ENGINEERS — DENVER EQUIPMENT 24 HOUR SERVICE COMPANY

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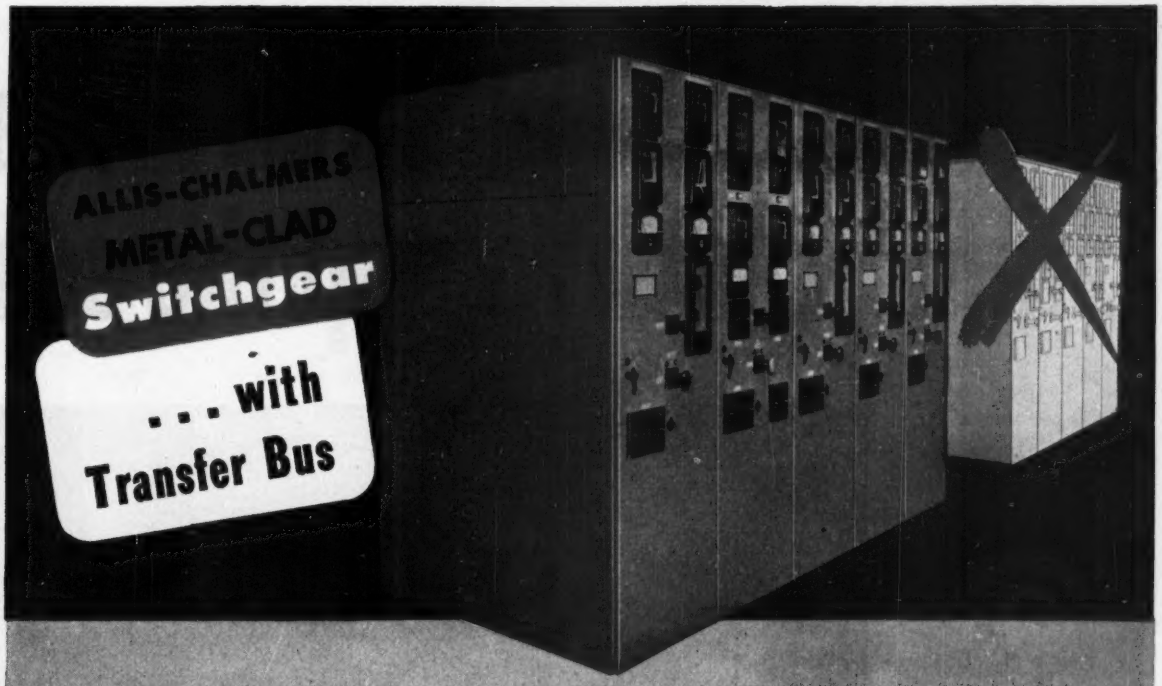
Chicago 1, Ill.
1123-24 Bell Bldg.
Phone Central 6-2423

Toronto 1, Canada
220 Bay Street
Phone Empire 3-8836

Offices also in El Paso, Vancouver, Mexico, D.F., London, Johannesburg



SAVES 1/3 the Cost

YOU PAY ONLY for the addition of the transfer bus . . . not a complete set of duplicate switchgear.

WHAT IS A TRANSFER BUS?

It's a by-pass bus circuit that parallels the main switchgear bus . . . . with means provided for switching loads to the transfer bus. This added bus makes it possible to withdraw and maintain circuit breakers, or inspect main bus without power outage. This method proved by utilities in hundreds of installations.

SAVES 1/2 the Space

ALLIS-CHALMERS supplies transfer bus right in the same cubicle as switchgear, without adding cubicles . . . thus cutting floor space requirements in half.

TAKE A TIP FROM UTILITIES! Their experience in many installations proves that you, too, can eliminate duplication of switchgear in many places . . . yet assure power continuity.

Ask an Allis-Chalmers engineer about transfer bus arrangements and what they can mean to your plant in savings and service. Call your nearby Allis-Chalmers district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

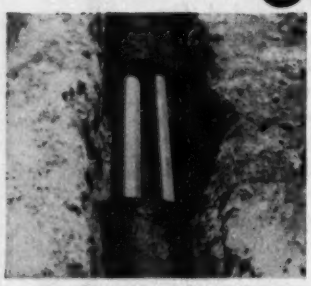
A-3887

ALLIS-CHALMERS

FROM A MINE IN UTAH:

THE DISCOVERY that practices and the cost

GILSULATE*...the triple-zone insulation hot underground pipes. It's water-proof,



GILSULATE forms its own massive circular sheath after backfill and normal introduction of heat (up to 520° F.) through pipes.

GILSULATE—nature's own insulation—is a unique, solidified hydrocarbon. It virtually installs itself: just pour it on...tamp...backfill—the job's insulated. Normal pipe-heat (up to 520° F.) does the rest—fuses the GILSULATE to the pipe in hours, forming a massive circular sheath. Three tough layers completely protect the pipe against heat loss, against water, all types of corrosion, any commonly-encountered buried-line condition. GILSULATE came from the earth and is simply being returned to the earth, where it has laid unchanged for millions of years.

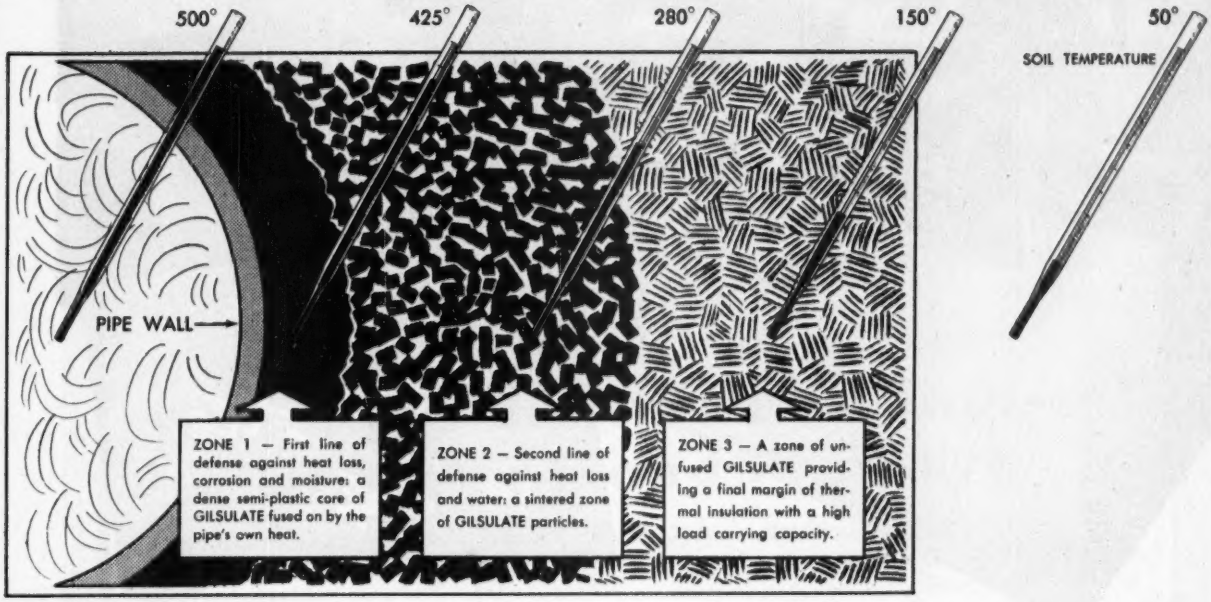
GILSULATE costs less installed per linear foot *than any other hot underground pipe installation*...it's easiest-to-use...and has been tested in scores of the country's largest and most important installations

For a demonstration, write or call your nearest dealer:

California	Los Angeles 15, Industrial Insulators, 1244 South Grand Avenue
	San Francisco 7, Western Fibrous Glass Products Co., 739 Bryant St.
Canada	Montreal, Engineering Equipment Co., Ltd., 874 Beaumont Ave.
	Toronto, Michael Stuart Co., Ltd., 116 Bloor St. West
Colorado	Denver 2, Jay and Cox, Inc., 2124 Broadway
Georgia	Atlanta, American Gilsonite Co., H. L. Armentrout, 831 Briarcliff Road
Illinois	Chicago 6, Roy O. Nelson Co., 330 South Wells Street
Indiana	Indianapolis 2, Jackson Engineering Co., Inc., 1531 N. Pennsylvania St.
Louisiana	New Orleans 6, Edgar Murray Supply Co., Inc., 232 Canal Street
Michigan	Detroit 26, John F. Wolff & Co., Penobscot Building, Rm. 702
Minnesota	St. Paul 14, Paul W. Abbott Co., 2288 University Avenue
Missouri	Kansas City 8, Andersen-Stolz Corp., 1727-33 Walnut Street
	St. Louis 1, Eagle Industrial Co., 119 North Seventh Street
New York	New York 7, A. F. Hinrichsen, Inc., 50 Church Street
	Syracuse 2, H. V. Boggs Co., 419 E. Jefferson Street
Ohio	Cleveland 6, William G. Jewett Co., 12417 Cedar Road
Oregon	Portland 4, Mead and Associates, 317 S.W. Alder St., Rm. 1100
Pennsylvania	McKees Rocks, Tutein and Bickell, 429 Broadway
Texas	Houston 11, Mundet Cork Corp., 6601 Supply Row
Utah	Salt Lake City 1, Williams, Gritton & Wilde, 204 Cooly Building
Washington	Seattle 66, Winsor Co., 20031 Marine View Drive, S.W.

* *GILSULATE is a blend of specially sized and selected Gilsonite, a unique solidified hydrocarbon of high resin content found only in eastern Utah. Gilsonite has been in use since 1887 in paints, inks, asphalt tile, storage battery boxes, etc. Its remarkable insulating properties are a recent discovery.*

can revolutionize the insulation of buried pipe installations...


500°
425°
280°
150°
50°
SOIL TEMPERATURE
PIPE WALL
ZONE 1 — First line of defense against heat loss, corrosion and moisture: a dense semi-plastic core of GILSULATE fused on by the pipe's own heat.
ZONE 2 — Second line of defense against heat loss and water: a sintered zone of GILSULATE particles.
ZONE 3 — A zone of unfused GILSULATE providing a final margin of thermal insulation with a high load carrying capacity.

that fuses itself into lifetime protection for corrosion-proof, root-proof, acid/alkali-proof

A few additional GILSULATE advantages:

- *3 grades available* covering 220°-520° F.
- *needs no sleeves* or mechanical sheaths to protect insulation
- *requires no mixing* or special handling
- *can't be punctured*—leave rocks in backfill
- *needs only normal pipe spacing*—steam and condensate lines can run side by side
- *pipe contracts and expands* within GILSULATE structure
- *repairs to pipe* are quick and easy
- *proved in actual use* in hundreds of new construction and replacement installations
- *widely preferred*—by heating, ventilating and mechanical engineers, architects, contractors in central steam installations, chemical and petroleum plants, construction projects, industrial power plants, utilities, and state institutions.

For descriptive literature, fill in the coupon below.

AMERICAN GILSONITE COMPANY
SALT LAKE CITY, UTAH
Affiliate of Barber Oil Corp. and Standard Oil Co. of California

GILSULATE can be used for replacement of old-fashioned, worn-out, or corroded insulation.

GILSULATE®

THE TRIPLE-ZONE INSULATION
FOR LIFETIME PROTECTION
OF HOT UNDERGROUND PIPES

American Gilsonite Co.
248 South Main St.
Salt Lake City 1, Utah,
or 1145 East Jersey Street, Elizabeth 4, N. J.

Please send me descriptive literature on GILSULATE.

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COMPANY .....

ADDRESS .....

CE

You will find *ideas in action* when you visit the Bailey Meter Exhibit, in Booth 30, at the 1953 Exposition of Chemical Industries.

For your process and power plant planning in '54 you will want the latest in measurement and control instruments. At the Bailey Exhibit you will see ways to use fuel at high efficiency—measure small rates of flow, simplify temperature measuring installations, reduce telemetering problems, brighten up plant appearance—and operate with a maximum of safety.

Your metering and control problems will be welcomed and held in the strictest confidence—come in and talk it over, or ask for a Bailey Engineer to call at your plant. G-33

These ideas for '54 will simplify and improve your process or power plant operation:

MINI-LINE Equipment—
A typical process control station, a performance demonstration, standardized components, and application diagrams show how you may use MINI-LINE equipment to:
- Concentrate control stations
- Use manpower to best advantages
- Minimize control room space requirements

ARMORTUBE Cable—
A flexible protected multi-tube cable which will cut your overall construction costs and improve the appearance of your pneumatic telemetering and control systems.

COMBUSTION MONITOR—
A new combination Oxygen and Combustibles Analyzer-Recorder to help you save fuel dollars especially in firing fuels of varying mixtures or composition. Also to protect against lighting off unpurged, gas-fired combustion chambers.

BAILEY METER COMPANY

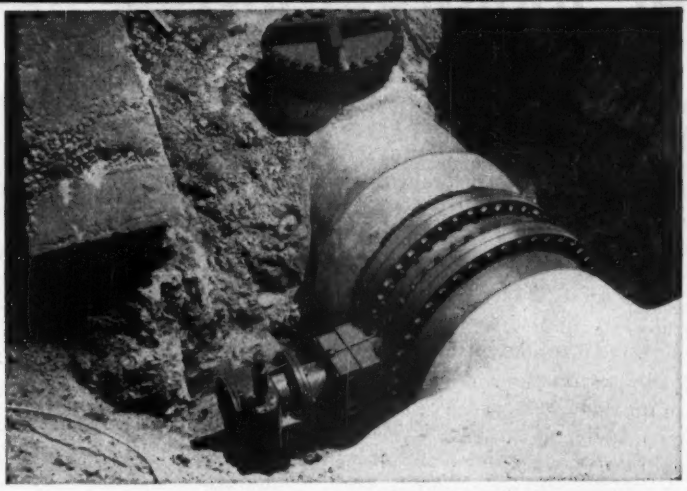
1054 IVANHOE ROAD • • • CLEVELAND 10, OHIO

Controls for Processing

TEMPERATURE
PRESSURE
% OXYGEN
% COMBUSTIBLES
FLOW
LEVEL
DENSITY
RATIO

R-S valvEvents

• EXCERPTS FROM THE R-S BOOK OF EXPERIENCE •



Simplified Control and Shut-off of Volume and Pressure

The underground application shows a 50-pound R-S Valve with gear reducer, lubricating lines and operating nut which is hand operated with a wrench. Only a few turns of the wrench are required to open or close the valve.

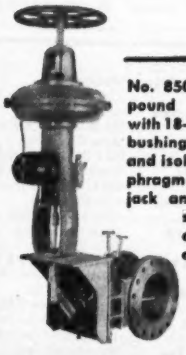
Practically every R-S Valve installation, particularly when automatically controlled, provides useful experience that can be applied in other industries although they may be far apart in classification. It is this accumulation of engineering experience coupled with unexcelled production facilities that can be so helpful to you.

Call the R-S representative at the inception of your application. Benefit by his research and engineering experience in the simplified control and shut-off of volume and pressure.

S. MORGAN SMITH Company • YORK, PA.

MANUFACTURERS OF HYDRAULIC TURBINES-VALVES

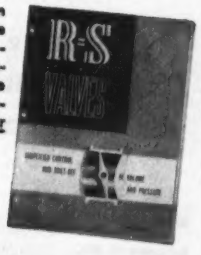
REPRESENTATIVES IN PRINCIPAL CITIES



No. 850—Ten-inch, 300-pound valve equipped with 18-8 shafts, hastelloy bushings, stick lubricators and isolating valves, diaphragm top with handjack and positioner. Installed for the flow control of sour crude petroleum.

No. 801—Three-inch, 125-pound bronze screwed end valve with handlever control and locking device. There is a size and type of R-S Valve for any industry or process.

Catalog No. 20 describes R-S Valves in detail—types, prime movers, applications and specifications. Contains more than 150 illustrations. Write for your copy.



Announcing new Parker *"In-tru"* Fittings for easier, foolproof installations

Simply push—then tighten! That's all you have to do to install the new Parker *"In-tru"* tube fittings. These flareless fittings are especially well suited for instrumentation lines of ¼" through ½" outside diameters. Here's what makes them so easy and foolproof to use . . . even by pickup labor on construction jobs:

To connect a Parker *"In-tru"* fitting, you don't have to take the fitting apart. Just do three things. First, cut off the tube squarely. Second, push the tube through the nut and ferrule until it rests on the seat within the fitting body. Then, tighten the nut.

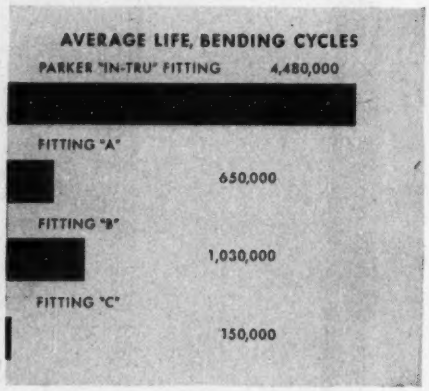
The wedging action of the nut, when tightened, causes the ferrule to "bite" into the outer surface of the tube wall. This turns up a shoulder of metal for a leakproof, vibration-proof connection. The cutting action of the ferrule is not hidden, so the extent of the "bite" is plainly visible if the joint is disconnected to examine the "bite".

Leakproof Parker *"In-tru"* fittings are made of brass. They are also available in aluminum alloy on special order.

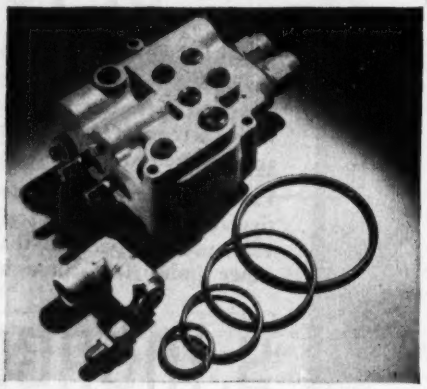
Call your nearest Parker distributor for complete information about shapes, sizes, and prices. Or, write us for Catalog 4320A1.

TUBE AND HOSE FITTINGS DIVISION
The Parker Appliance Company
Section 4020, 17325 Euclid Avenue, Cleveland 12, Ohio

Parker
Hydraulic and fluid system components



Vibration life tests proved Parker *"In-tru"* fittings averaged four-times longer life than any of the three competitive makes tested.



What other Parker products interest you? Triple-lok flare fittings? Hydraulic control valves? O-rings? Write us for information.

CALL YOUR NEAREST DISTRIBUTOR FOR PARKER INDUSTRIAL FITTINGS

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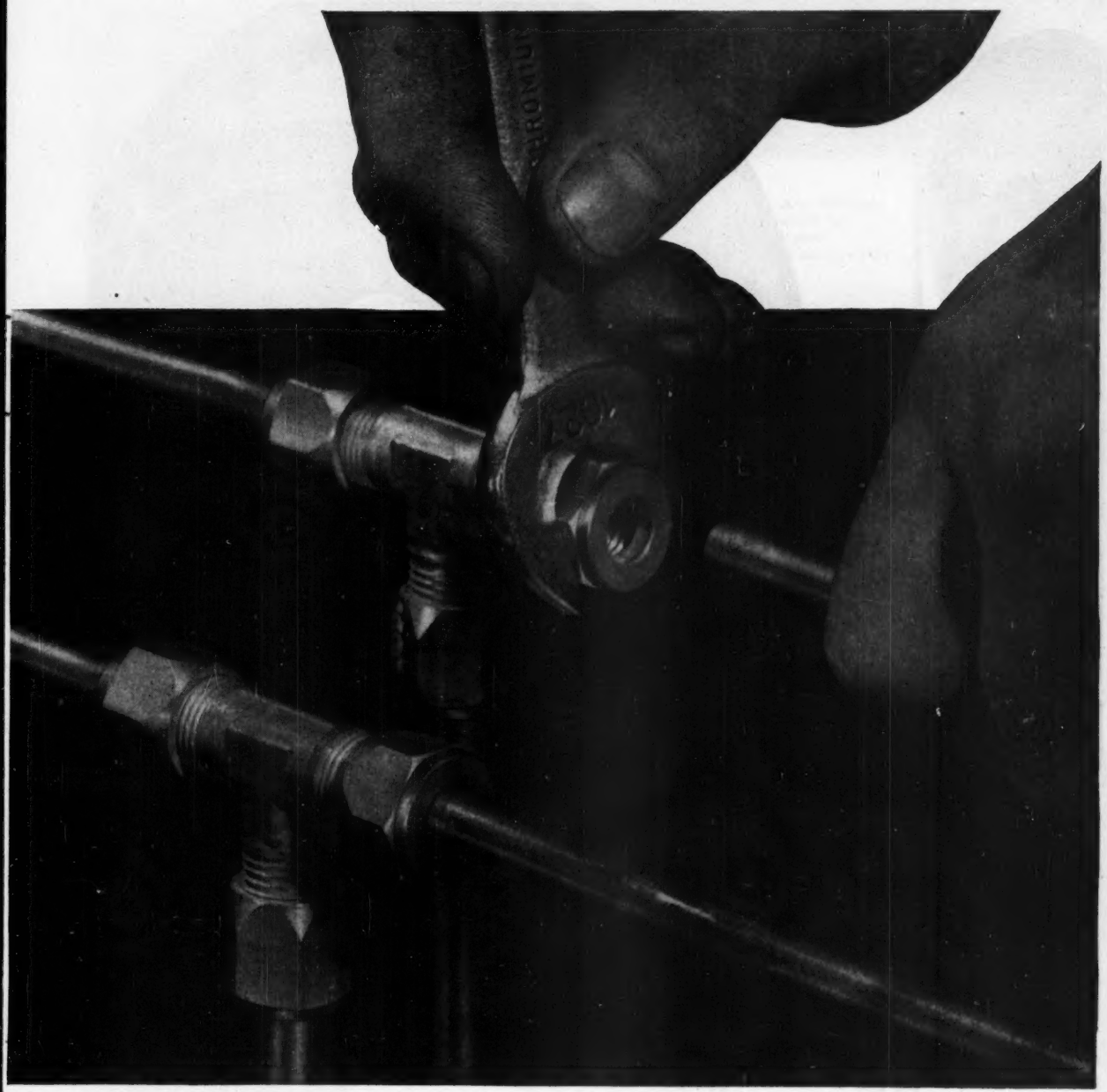
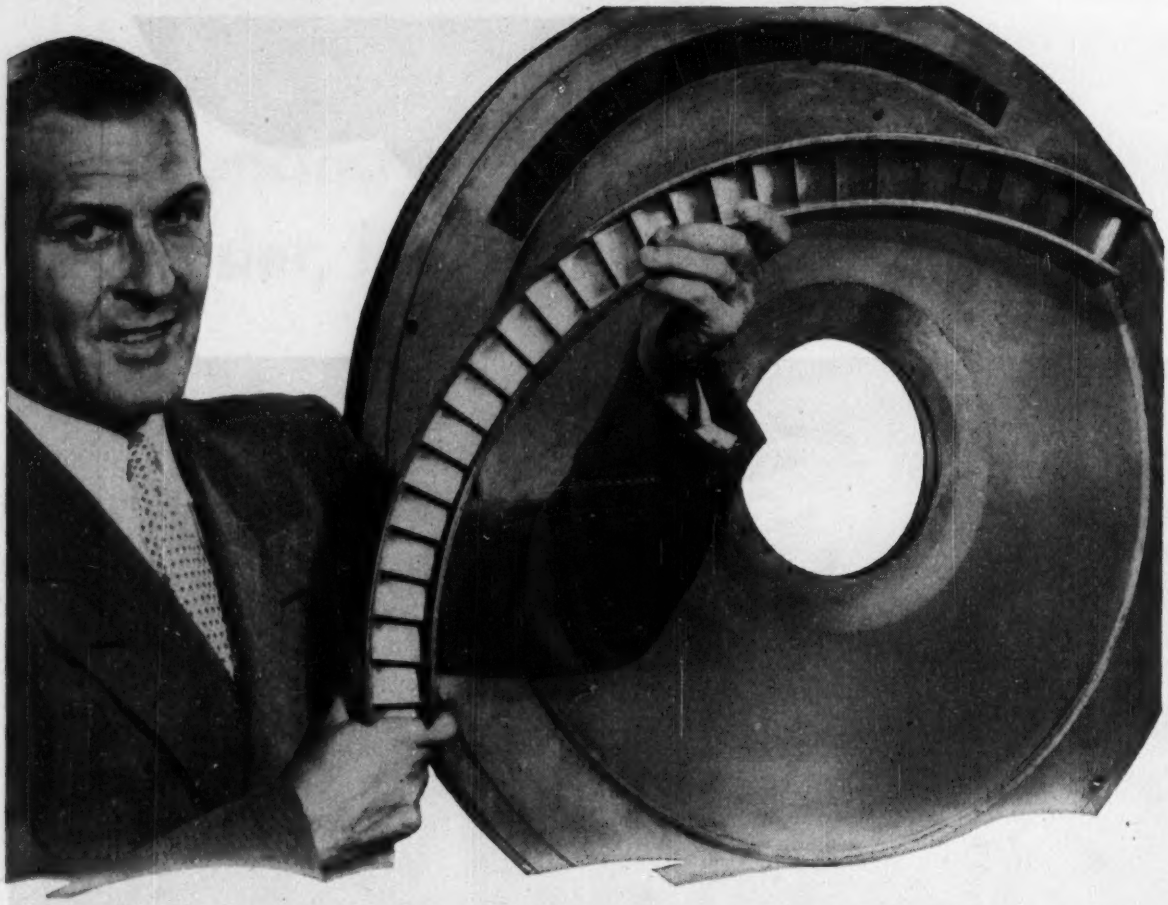
Boston 15, Mass.	A. E. Borden Co., Inc. 176 Brookline Ave.
Bryson City, N. C.	Wallace Co. of N. C. P. O. Box 572
Buffalo 7, N. Y.	Whitehead Metal Products Co. 2128 Elmwood Ave.
Cambridge 39, Mass.	Whitehead Metal Products Co. 281 Albany St.
Cedar Rapids, Ia.	Globe Machinery & Supply Co. 309 8th Ave. S. E.
Charleston, W. Va.	Persingers, Inc. 514 Elizabeth St.
Charlotte 1, N. C.	Industrial Piping Supply Co. 1501 Dowd Rd.
Chicago 14, Ill.	Wallace Tube Co. 1300 Diversey Parkway
Cincinnati 29, Ohio	Williams & Co. 3231 Fredonia Ave.
Cleveland 14, Ohio	B. W. Rogers Co. 1279 East 12th
Cleveland 14, Ohio	Williams & Co. 3700 Perkins Ave.
Columbus 8, Ohio	Williams & Co. 851 Williams Ave.
Dallas 9, Tex.	Metal Goods Corp. 6211 Cedar Springs Rd.
Davenport, Ia.	Globe Machinery & Supply Co. 410 E. Second St.
Dayton 10, Ohio	J. N. Fauver Co. 1534 Keystone Ave.
Denver 2, Colo.	Metal Goods Corp. 2425 Walnut St.
Des Moines 6, Ia.	Globe Machinery & Supply Co. East First & Court Ave.
Detroit 1, Mich.	J. N. Fauver Co. 49 West Hancock St.
Harrison, N. J.	Whitehead Metal Products Co. 1000 South Fourth Ave.
Houston 3, Tex.	Metal Goods Corp. 711 Milby St.
Houston 1, Tex.	Standard Brass & Mfg. Co. 2018 Franklin St.



Simply push, then tighten. Anyone can quickly install new Parker "*In-tru*" tube fittings. You don't even have to take them apart before making connections. These flareless fittings are both leakproof and vibration-proof. They are designed for instrumentation lines using ¼" through ½" outside diameters.

Indianapolis, Ind.	Avels Sales & Engineering Co. 16 W. 22nd St.	**New Orleans 12, La.**	Metal Goods Corp. 432 Julia St.	**Salt Lake City 4, Utah**	Pace-Turpin & Co. 726 South Third West
Jacksonville, Fla.	Florida Metals, Inc. 2937 Strickland St.	**Newport News, Va.**	Noland Company 27th St. & Virginia Ave.	**San Francisco 3, Cal.**	General Machinery & Supply Co. 1346 Folsom St.
Kansas City 16, Mo.	Metal Goods Corp. 1300 Burlington Ave.	**New York, N. Y.**	Nielsen Hydraulic Equipment, Inc. 5 Penn Place, Pelham Manor 65	**Seattle 9, Wash.**	Palmer Supply Co. 222 Westlake North
Knoxville 5, Tenn.	Leinart Engineering Co. 412 E. 5th Ave.	**New York 14, N. Y.**	Whitehead Metal Products Co. 303 W. 10th St.	**Shreveport, La.**	Standard Brass & Mfg. Co. 1557 Texas Ave.
Los Angeles, Cal.	Haskel Engineering & Supply 721 Broadway, Glendale 4	**Odessa, Tex.**	Snyder Co., Inc. 2604 Kermit Highway	**St. Louis 15, Mo.**	Metal Goods Corp. 5239 Brown Ave.
Los Angeles 12, Cal.	Metropolitan Supply Co. 353 E. 2nd St.	**Philadelphia, Pa.**	Louis H. Hein Co. 15 W. Lancaster Ave., Ardmore	**Syracuse 4, N. Y.**	Whitehead Metal Products Co. 207 W. Taylor St.
Memphis, Tenn.	J. E. Dilworth Co. 730 South Third St.	**Philadelphia 40, Pa.**	Whitehead Metal Products Co. 1955 Hunting Park Ave.	**Tampa, Fla.**	Florida Metals, Inc. 222 N. 12th St.
Miami, Fla.	Florida Metals, Inc. 4100 N. W. 37th Ct. Hialeah	**Pittsburgh 33, Pa.**	Williams & Co. 901 Pennsylvania Ave.	**Toledo 2, Ohio**	Williams & Co. 650 E. Woodruff Ave.
Milwaukee 3, Wis.	Morman Belting & Supply Co. 522 W. State St.	**Portland 10, Ore.**	Hydraulic Power Equipment Co. 2316 N. W. Savier St.	**Tulsa, Okla.**	Ardun Supply Co. 303 S. Frankfort
Milwaukee 4, Wis.	Wallace Companies of Wisconsin, Inc. 838 South 6th St.	**Roanoke 10, Va.**	Noland Company 1226 Center Ave. N. W.	**Tulsa 3, Okla.**	Metal Goods Corp. 302 N. Boston
Minneapolis 15, Minn.	Vincent Brass & Copper Co. 124 Twelfth Ave. South	**Rockford, Ill.**	Rockford Tool & Transmission Co. 802 Broadway	**Export**	Mercator Corp. 438 Walnut St., Reading, Pa., U.S.A.



"This weld-free steam path speeds steam flow, preserves turbine efficiency"

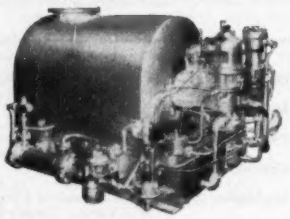
One reason for the higher, *long-term* efficiencies in Westinghouse Turbines is the special attention given to *preserving* the designed steam flow path. Example: diaphragm nozzle sections where every single weld fillet has been *eliminated* from the steam path. Here's how:

The nozzle vanes are first assembled between inner and outer strips, held in a precision jig. The nozzle vanes project into accurately spaced holes in the strips. This permits welding around the *outside* of the section—*completely* away from the steam path. The complete section is then welded into the diaphragm. Specially engineered for use in multi-stage turbines, this precise manufacturing technique provides an absolutely smooth and accurate steam path without the slightest weld fillet or other deviation from design to impair stage-to-stage flow. It is extra assurance that driving power and efficiencies will be maintained throughout the life of the turbine.

The weld-free diaphragm nozzle is just one of the continuing engineering refinements Westinghouse uses to give its turbines unusual *long-term* efficiency. The knowledge and manufacturing techniques gained from over 50 years' experience—on 1 hp to the largest made—make possible this and the many other features which deliver decade after decade of unfailing service. Make sure your next steam drive has *long-term* efficiency. Expert Application Engineers will help you select the right unit from a complete line of General-Purpose Turbines. Call your local Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-50561

Multi-stage, Single-valve, General-purpose Turbine

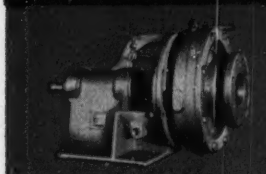
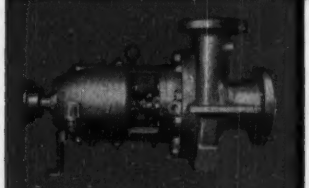
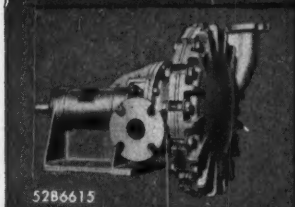
One of the multi-stage line which benefits from improved steam flow using weld-free diaphragm nozzles. Available in ratings from 100 to 2000 hp, 1000 to 7500 rpm, for driving all types of pumps, fans, compressors, generators and special-purpose machines. This advanced design is adaptable to almost any steam condition.



YOU CAN BE SURE...IF IT'S Westinghouse

Turbines for every industrial use

Find the Best Pump for Your Process Job Here—

	TYPE	APPLICATION	SIZE RANGE	SPECIAL FEATURES
 Frame Mounted 52B6351, 52B6105 Close-coupled 52B6083, 52B6140	**SSB** Single suction Frame mounted Grease lubricated Also available close-coupled	General purpose use	Heads to 550 feet. Capacities to 3500 gpm. Temperatures to 250 F.	Available in many materials. Choice of packing, single or double mechanical seal. Bearings protected from corrosive or abrasive atmosphere.
52B7638, 52B6105 (Multi-stage)	**SSB** Single suction Frame mounted Oil lubricated	Chemical, petroleum and general purpose use in medium high temperature range	Heads to 550 feet. Capacities to 3500 gpm. Temperatures to 550 F.	Available in many materials. Choice of packing, single or double mechanical seal. Stuffing box cooled above 250 F.
 52B7775	**Refinery Type R** Single suction Frame mounted Oil lubricated	Volatile liquids and high temperature process applications requiring heavy duty refinery type pump	Heads to 600 feet. Capacities to 1300 gpm. Temperature to 800 F.	Available in many materials. Choice of packing, single or double seals. Stuffing box, bearings, and pedestal may be water cooled.
 52B6615	**P and PD** Single suction Frame mounted Grease lubricated	Handling fine abrasives in suspension or corrosive liquids	Heads to 260 feet. Capacities to 1300 gpm. Temperatures to 250 F.	Stuffing box on suction side. Choose packing, mechanical seal or *Equiseal* stuffing box — stops leakage to 15 feet suction head. Open or closed impeller.
52B7112 (PW) 52B6381 (CW)	**PW — CW** Single suction Frame mounted Grease lubricated	Handling slurries and pulps which combine corrosive liquid with suspended solids	Heads to 270 feet. Capacities to 10,000 gpm. Temperatures to 250 F.	Available in many materials. Choice of packing or mechanical seal. Easy to disassemble for inspection or repair.

Complete Pumping Unit with Undivided Responsibility

HERE'S what you can get from Allis-Chalmers: Complete pumping unit — pump, drive, motor and control — ready to install and run. You save installation time. All parts are of coordinated design... built to run together. You get one dependable guarantee of satisfaction for complete installation.

Your nearby Allis-Chalmers District Office representative will be glad to help you with your process pumping problems. Or for complete information on Allis-Chalmers pumps for the chemical industry, write for the bulletins indicated in the table above. Allis-Chalmers, Milwaukee 1, Wis.

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ALLIS-CHALMERS

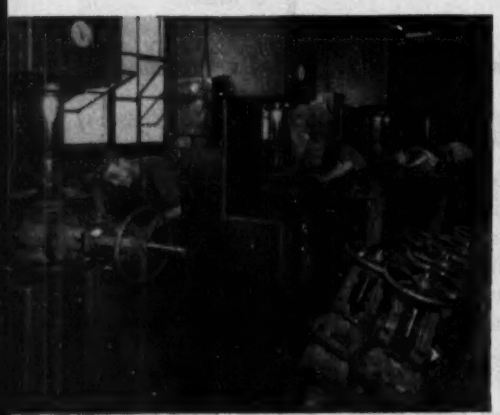
A-C ALLIS-CHALMERS A-4132

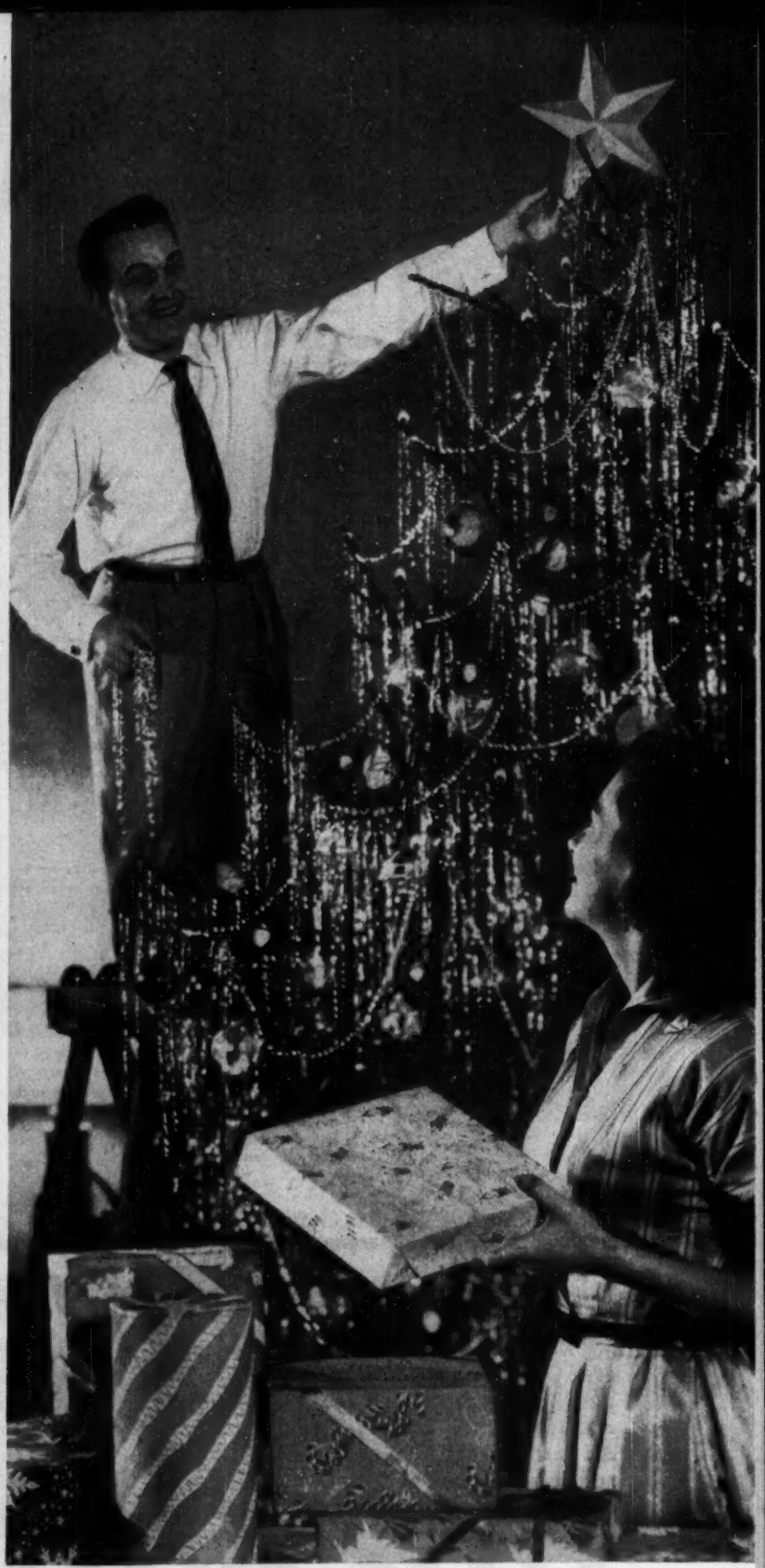
The Finishing Touch

Small details can make a big difference in trimming a tree . . . and in manufacturing valves. For example, *every* Powell Valve part must pass *rigid inspection.* Then, as a final, finishing touch, each Powell Valve is subjected to *actual line tests.*

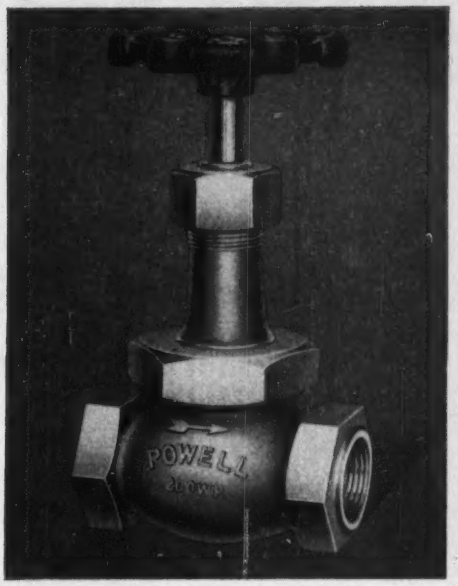
It's these seemingly small details that have helped Powell Valves maintain their record of dependability since 1846. Powell has probably done more valve research, solved more valve problems, and makes more types of valves than any other organization in the world.

With Powell Valves on the job in your plant, you'll say every day's a holiday from flow control worries. Following are just a few of the valves that have the gift of dependable service you want—and need. They're available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line.

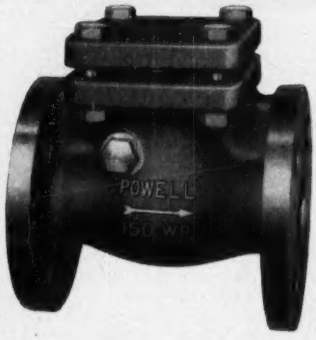




STAINLESS STEEL O.S. & Y. "Y" VALVE *(Fig. 1944)* for 150 pounds W.P. at 500 F. The stem is threaded, guided and rises through a bronze bushing in the upper yoke. Made with flanged ends only, with flange dimensions conforming to MSS SP-42. Sizes 2½" to 12", inclusive.

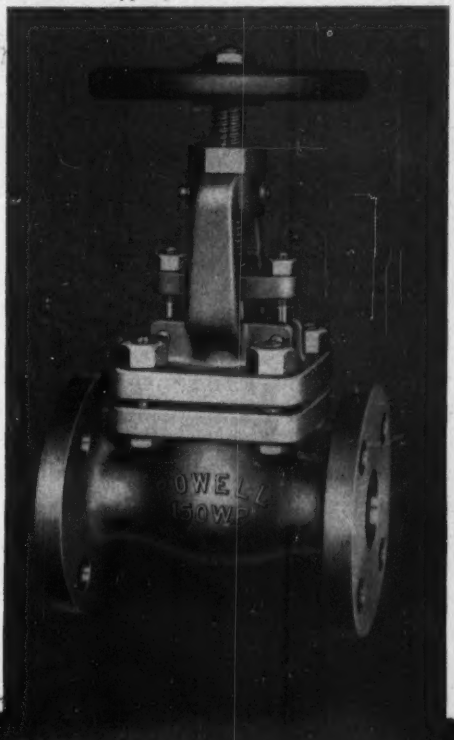


STAINLESS ALLOY GLOBE VALVE *(Fig. 1861)* for 200 pounds W.P. at 500 F. Union bonnet, screwed ends. Sizes, ¼" to 2", inclusive. Sizes 2½" and 3" furnished with bolted flanged bonnet.

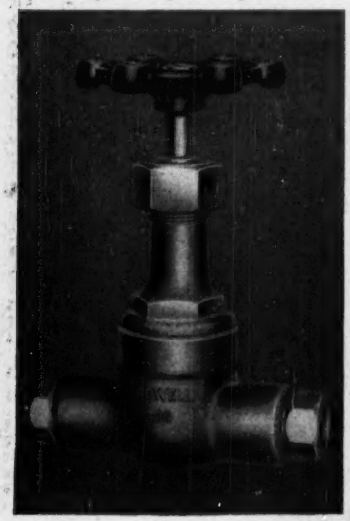


STAINLESS STEEL SWING CHECK VALVE *(Fig. 2342)* with flanged ends for 150 pounds W.P. at 500 F. Sturdily built for severe service. Bolted flanged cap. Disc, hung on 5° angle, permits straight, unobstructed flow through. Available in sizes ¼" to 3", inclusive.

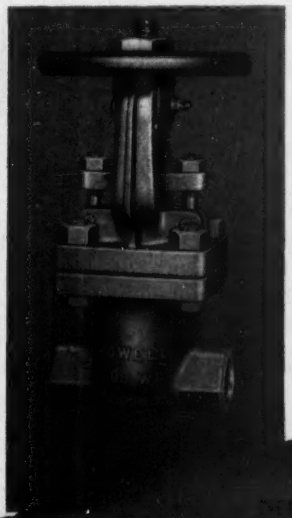
STAINLESS STEEL O.S. & Y. GLOBE VALVE *(Fig. 2475)* for 150 pounds W.P. at 500 F. Plug-type disc is screwed into and pinned securely to lock nut. Long stem is threaded and guided through bronze bushing screwed in upper yoke. Sizes, ¼" to 3", inclusive.



KONCENTRIK-FITTED 200 POUND STAINLESS STEEL GATE VALVE *(Fig. 1832K)* for corrosion-resistant tubing up to 1" O.D. Screw-in bonnet, inside screw rising stem. Solid wedges regularly furnished: split wedges on special order.



ALUMINUM O.S. & Y. GATE VALVE *(Fig. 2442)* for 100 pounds W.P. at 350 F. Type 304 or 18-8 Stainless Steel stem and interchangeable solid or double wedges. Sizes ¼" to 2", incl.



DEPENDABLE VALVES SINCE 1846

Powell Valves

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HERE'S PROOF...

that LINK-BELT's Fluid Drive with constant CUSHION ACTION cuts machinery wear and tear

Cutaway shows simple, rugged construction of Link-Belt Fluid Drive.

NOW you can use smaller motors and power transmission equipment on your toughest drive problems. What's more, both motors and driven machines will last longer with Link-Belt Fluid Drives.

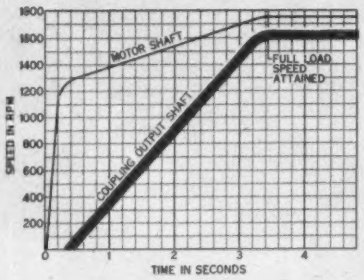
That's because constant CUSHION ACTION provides shock and overload protection . . . and at the same time eliminates high starting torque requirements and high starting currents.

Look at the three sets of curves shown here. See for yourself how constant CUSHION ACTION is the money-saving answer for loads of the high inertia, repetitive shock or high starting torque type.

For complete information, write for Book 2485. It shows how you can put five types of Link-Belt Fluid Drives to work in your plant: Electrofluid Drive, Electrofluid Gearmotor, Fluid Drive, Fluid Gear Drive and Fluid Coupling Drive. 52,853

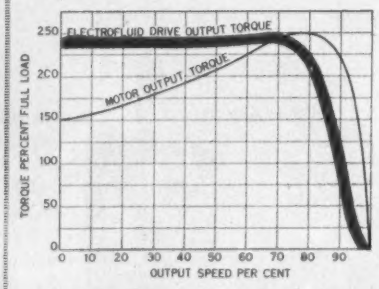
LINK-BELT
FLUID DRIVES

Smooth acceleration - -



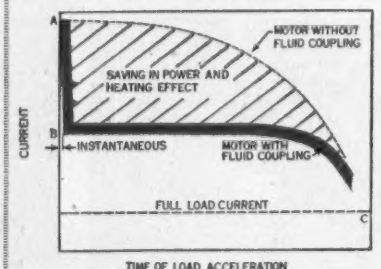
Typical motor and coupling acceleration curves for a high-inertia load show how CUSHION ACTION smoothly and gradually accelerates the load, saving wear and tear on vital equipment.

No overpowering - -



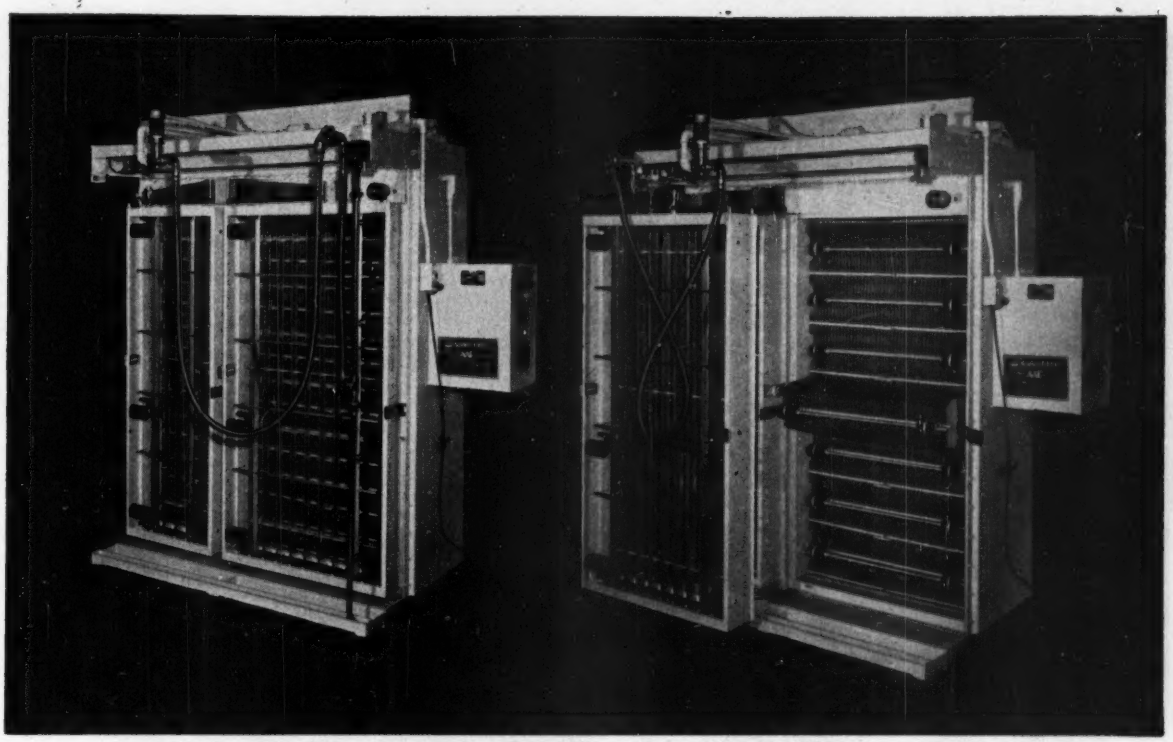
Compare the output torque of a motor with and without the fluid coupling. Because motor accelerates free of load, it reaches maximum pull-out torque that might otherwise require a special type of oversize motor.

Low starting current - -



As these current consumption curves show, with the fluid coupling, motor starting current drops instantaneously to less than half the starting current required by a motor without fluid coupling. Difference represents power savings, reduced heating.

LINK-BELT COMPANY: Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Springs (South Africa). Offices, Factory Branch Stores and Distributors in Principal Cities.



The Type "H" Washer incorporated as an integral part of an ELECTRO-CELL precipitator provides "push button" control of the cleaning operation. The washer travels on an overhead trackway which keeps it operating freely. The vertical header carrying the spray nozzle is rotated at each end of the travel to provide the necessary 5 degree lead to assure thorough cleaning of the plates. RIGHT: Shows how the hinged ionizers can be opened freely to permit removal or inspection of the plate cells.

ANNOUNCING THE **NEW** ELECTRO-CELL TYPE "H" WASHER
with push button control

Here's another *first* from the engineering department of American Air Filter Company. The new Type "H" Washer on the famous ELECTRO-CELL precipitator is a major contribution to the field of electronic air cleaning equipment—another important reason for AAF leadership!

Fully automatic, the spray head moves back and forth across the face of the removable plate cells. Accumulated dirt and dust is washed away—maintaining the high cleaning efficiency of the ELECTRO-CELL . . . which provides super clean air for many critical industrial and commercial uses.

The new Type "H" Washer has many advantages including its nominal cost. It in no way interferes with the opening of the hinged Ionizers or removing the plate cells.

Another exclusive feature of the new Type "H" Washer is the positioning of the spray-heads. These are automatically adjusted to always point at a 5 degree angle in the direction the spray-heads are travelling. This insures thorough washing action over the entire depth and each side of each individual plate.

The water used by the sprayer is controlled by a solenoid valve connected with the spray-head motor drive and is synchronized with the travelling spray-heads.

The ELECTRO-CELL, long famous in the field of electronic air cleaning, removes dust, dirt and even smoke from the air. With the addition of the Type "H" Washer it is even more efficient and practical to operate . . . and maintenance is reduced to a minimum!

Write the American Air Filter Company for technical data and descriptive information on this latest AAF achievement. AAF experience will help you solve all of your air cleaning problems.

expect the best from . . . . . AAF

American Air Filter
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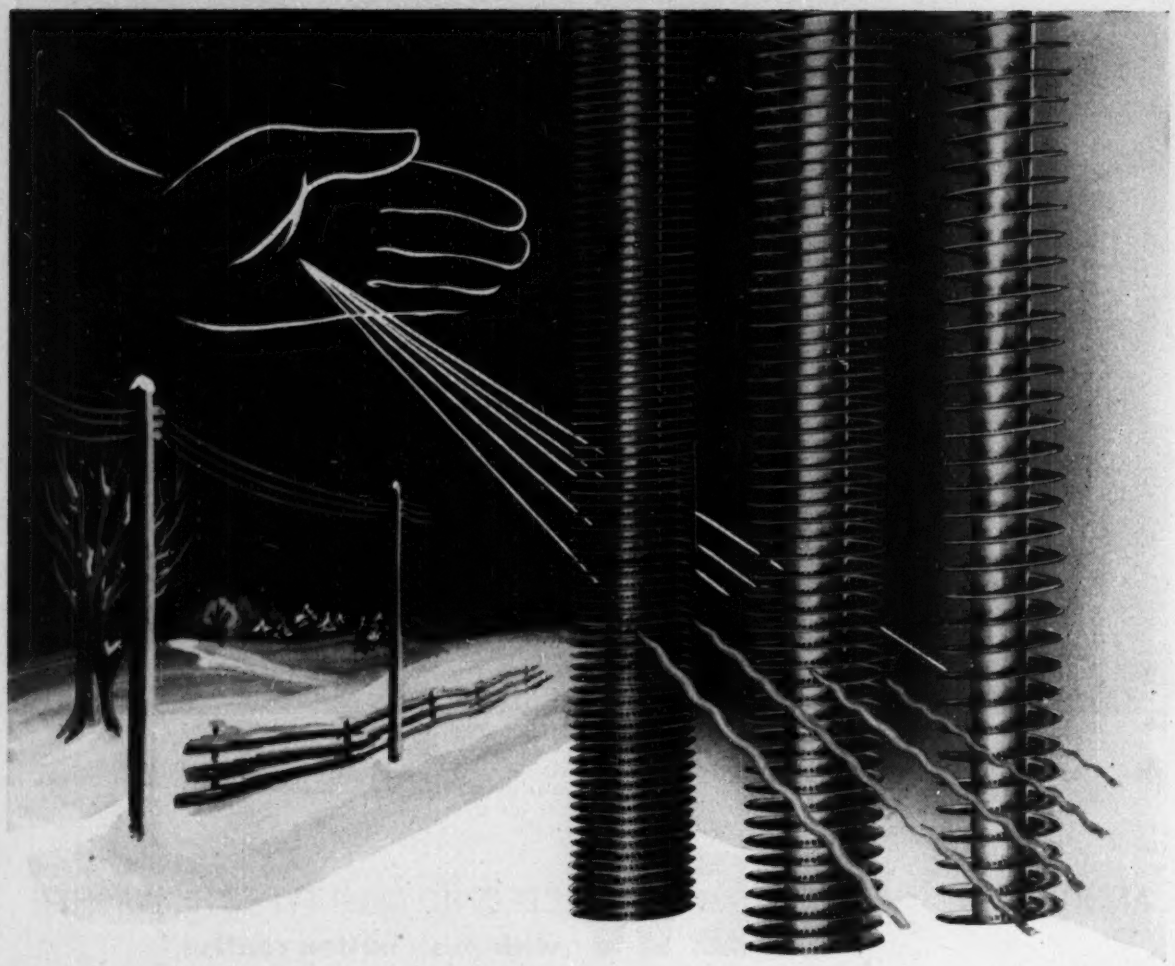
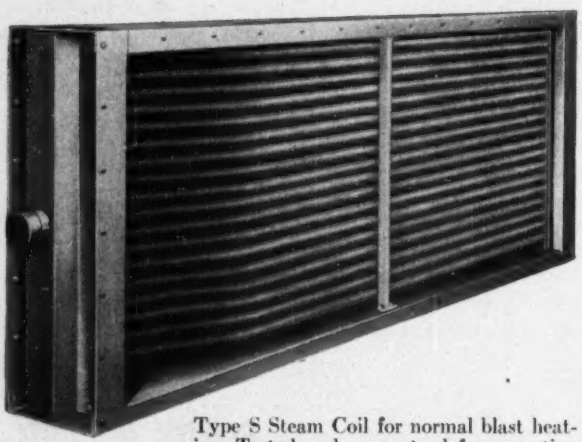


Check winter's icy hand with American Blower Heating Coils

They're quality-built. All tubing is helically wound with copper or aluminum fins in three standard spacings (see above). Coil casings are made of heavy galvanized steel; headers are of die-formed steel.

Whether you need coils for blast heating, zone reheating or whether you want return bend coils or coils for modulated steam control—you'll find the size and type that best fits your needs in the American Blower line. Write for further data.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation



Type S Steam Coil for normal blast heating. Tested and guaranteed for operation with steam up to 200 lbs. gauge pressure and 450° F temperature. Die-formed tube support protects tubes. Write for Bulletin B-1218.

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YOUR BEST BUY IN AIR HANDLING EQUIPMENT

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Here's the NEW GAS BALLAST PUMP backed by MILLIONS OF HOURS of trouble-free operation

Ends Water Vapor Trouble
Maintains Fast Pump Down Time

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Capacities from 1¼ cfm to 400 cfm
Pressures Down To 10^{-5} mm Hg

Here's important news for everyone who works with high vacuum. The new NRC Rotary Gas Ballast Pump gets it for you faster — saves you time and money and is backed by millions of hours of trouble-free operation.

By keeping water vapor from condensing, this pump prevents contamination of the pump oil. The result—it never loses capacity like conventional rotary pumps when pumping condensable vapors. It continually maintains a fast pump down rate.

NRC Rotary Gas Ballast Pumps are available in a complete line of vane, piston-type and 2-stage pumps.

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Seventy Memorial Drive, Cambridge, Massachusetts

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VALVES, FITTINGS and FLANGES

by

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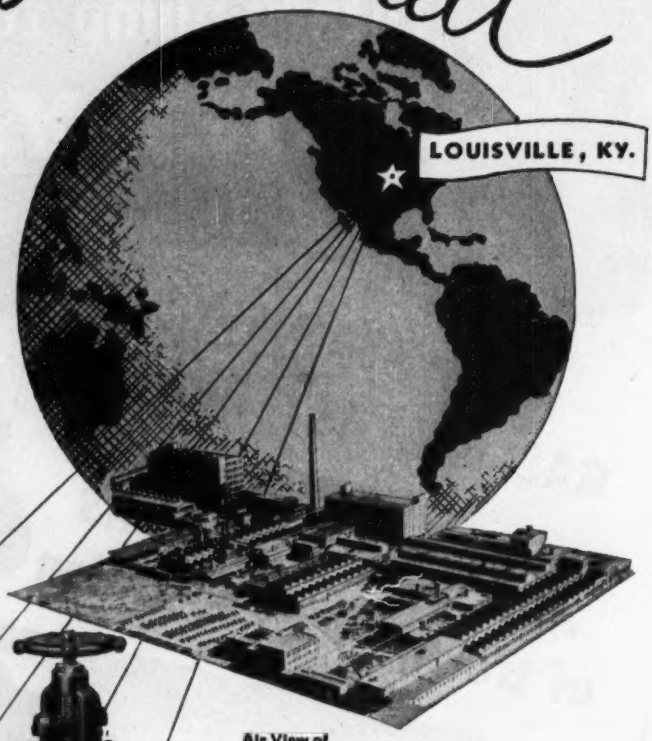

Air View of
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This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

OUR COMPLETE LINE INCLUDES

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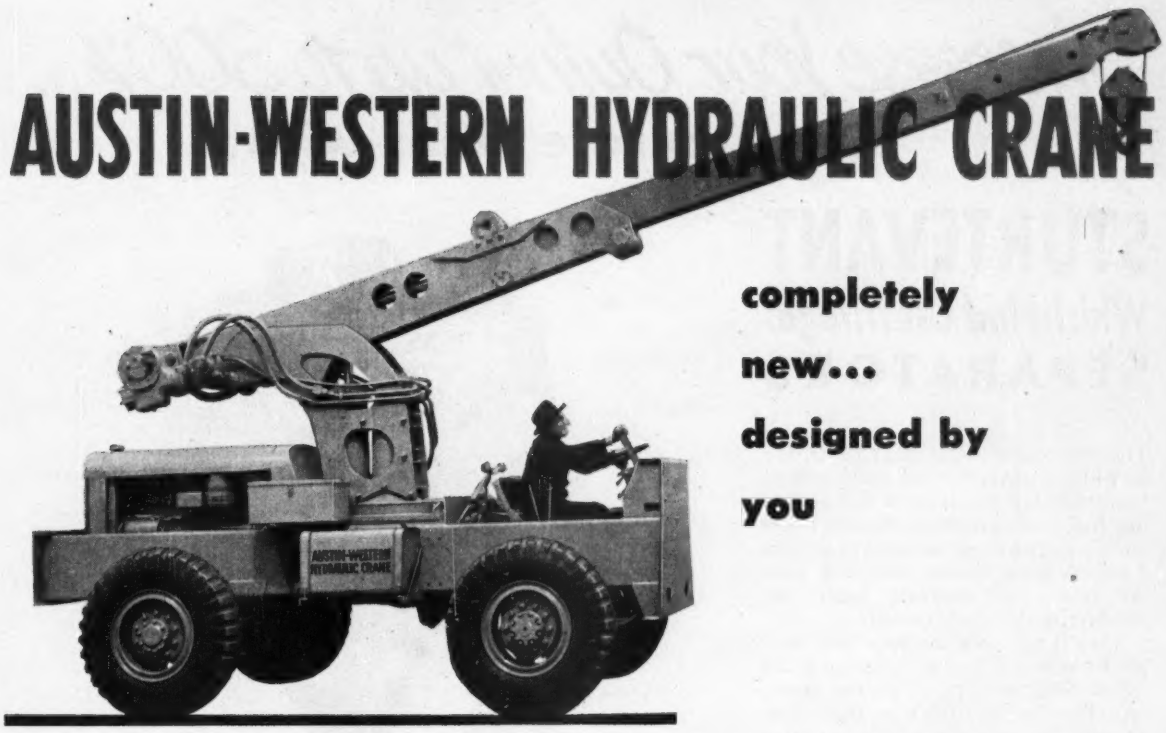
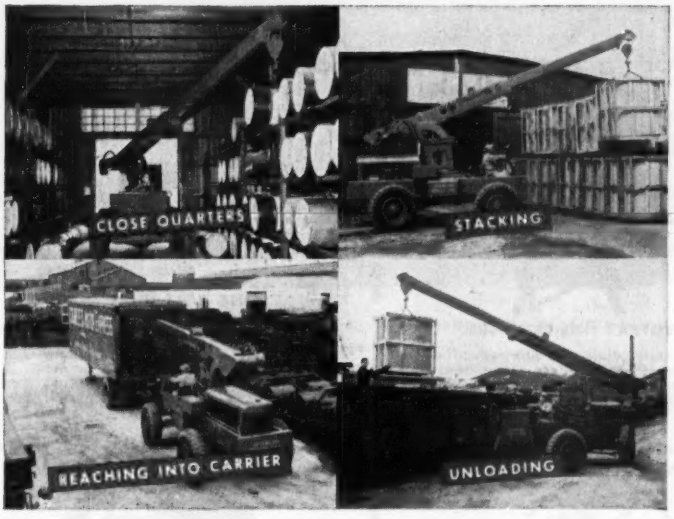


completely new... designed by you

the crane of unlimited indoor-outdoor use



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Completely hydraulically operated including

Continuous 360° turntable rotations
Extension and retraction of the boom
Raising and lowering of the cable
Boom elevation

This amazing, new, self-propelled Hydraulic Crane, with its pickup, carrying and placement capabilities combines the best features of crawler, truck and erection cranes with those of industrial shop cranes . . . and, like all other Austin-Western products, it's "Built to Outperform".

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Get Accurate Fines with...

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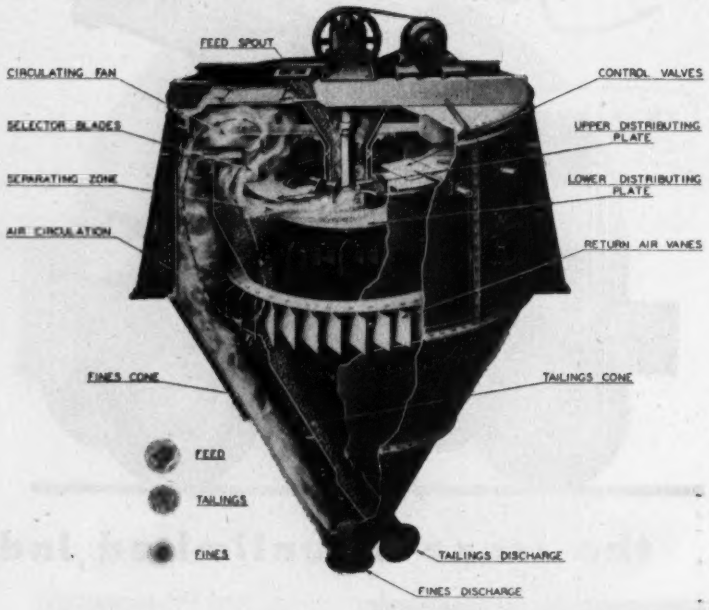
Whirlwind Centrifugal SEPARATORS

The Sturtevant Air Separator is one investment that pays off daily profits by increasing production and reducing costs. Its extremely efficient operation assures finer separation of fine material from coarse material with the result that uniform quality of product is always obtained.

They'll not only increase your output by as much as 300%, but provide 10 to 50% savings in power costs, too. They are available in sizes 3 to 16 feet in diameter with capacities from ¼ to 50 tons per hour with a fine-product range of 40 to 325 mesh or finer. Bulletin 087 gives the entire story. Write for your copy.



Other Sturtevant Equipment for Increasing Production and Cutting Costs

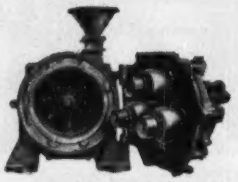
MICRONIZER® GRINDING MACHINE

A fluid jet grinding machine, the Sturtevant Micronizer speeds reduction of materials to low micron sizes. These jet mills are especially applicable in fields where a particle size in microns is desired.

Sturtevant Micronizer grinding machines are available in many sizes and capacities.

ROTARY FINE CRUSHERS

for intermediate and fine reduction (1" to ¼"). Open door accessibility. Soft or moderately hard materials. Efficient granulators. Excellent preliminary Crushers preceding Pulverizers.

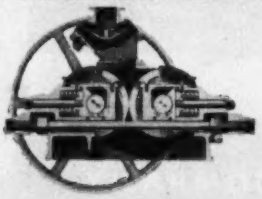


RING-ROLL MILLS

for medium and fine reduction (10 to 200 mesh), hard or soft materials. Very durable, small power. Operate in closed circuit with Screen or Air Separator. Open door accessibility. Many sizes. No scrapers, plows, pushers, or shields.

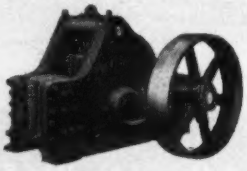
SWING-SLEDGE MILLS

for coarse and medium reduction (1" to 20 mesh). Open door accessibility. Soft, moderately hard, tough or fibrous substances. Built in several types and many sizes.



CRUSHING ROLLS

for granulation, coarse or fine, hard or soft materials. Automatic adjustments. Crushing shocks balanced. For dry or wet reduction. Sizes 8x5 to 58x20. The standard for abrasives.



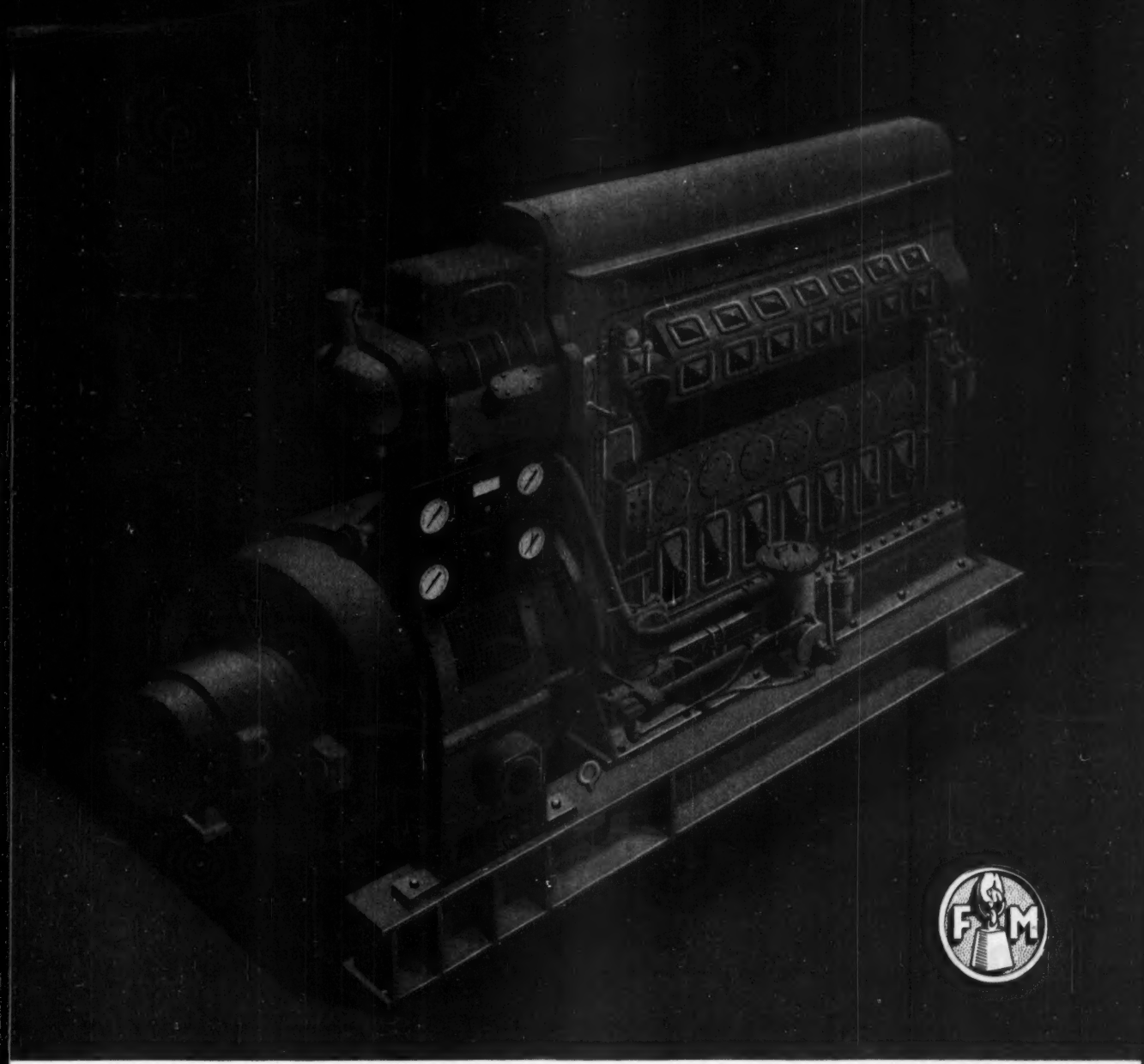
JAW CRUSHERS

for coarse, intermediate and fine reduction of hard or soft substances. Heavy or light duty. Cam and Roller action. Special crushers for Ferro-alloys. Several types, many sizes.

STURTEVANT MILL COMPANY

100 CLAYTON STREET, BOSTON 22, MASSACHUSETTS

DESIGNERS & MANUFACTURERS OF CRUSHERS • GRINDERS • SEPARATORS • CONVEYORS • MECHANICAL DENS AND EXCAVATORS • ELEVATORS • MIXERS



The Fairbanks-Morse Opposed Piston Diesel Model 38F 5¼. 225 to 750 horsepower.
Diesel Dual Fuel and Spark-ignition options.
Other O-P engines available in horsepower ratings to 2400.

. . . the price is more but the cost is less

You can buy many diesels for a little less than this Fairbanks-Morse OPPOSED PISTON Diesel . . . but no engine working at rated load can deliver power more reliably at less cost. The slightly higher price is quickly offset by the freedom from maintenance and service interruptions.

More engine hours of unfailing service mean fewer man-hours in maintenance and repair.

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a name worth remembering when you want the best

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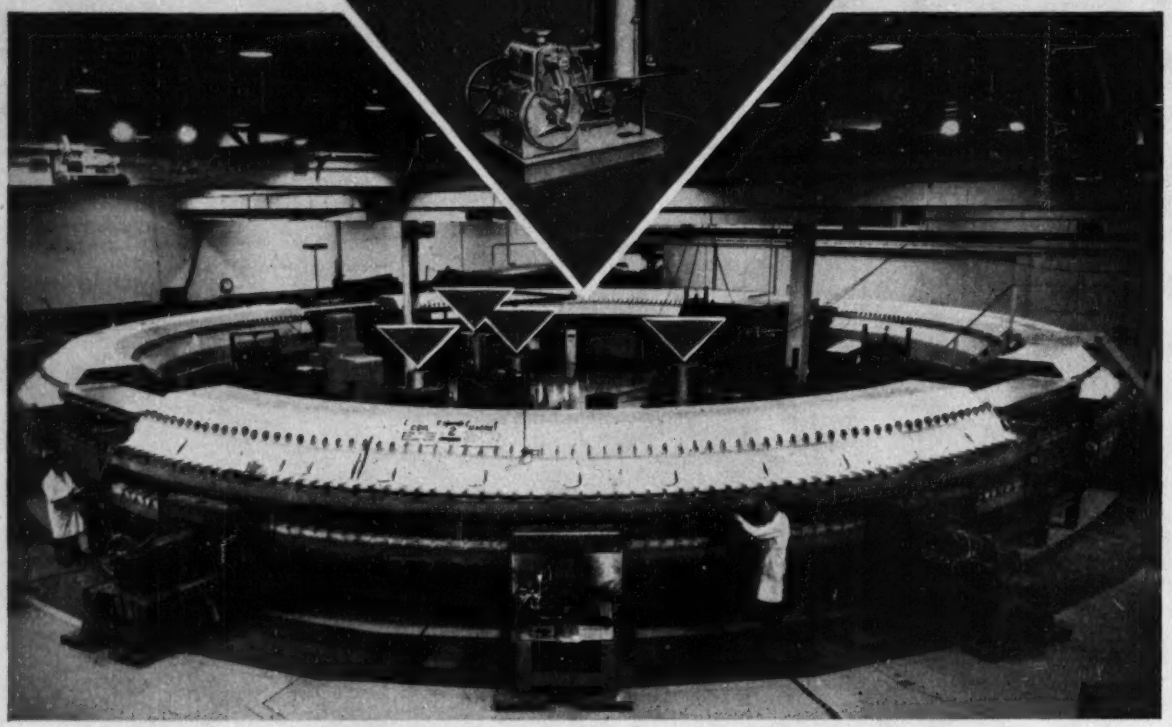
KINNEY MOD[illegible] VACUUM PUMP



Good vacuum lets particles go to 2,300,000,000 electron volts

Four Kinney Model DVD 14.9.18 High Vacuum Pumps help the Brookhaven Cosmotron get down to business in a great big hurry. This gigantic magnet-type accelerator is roughed down to 50 microns in a matter of ten to fifteen minutes.

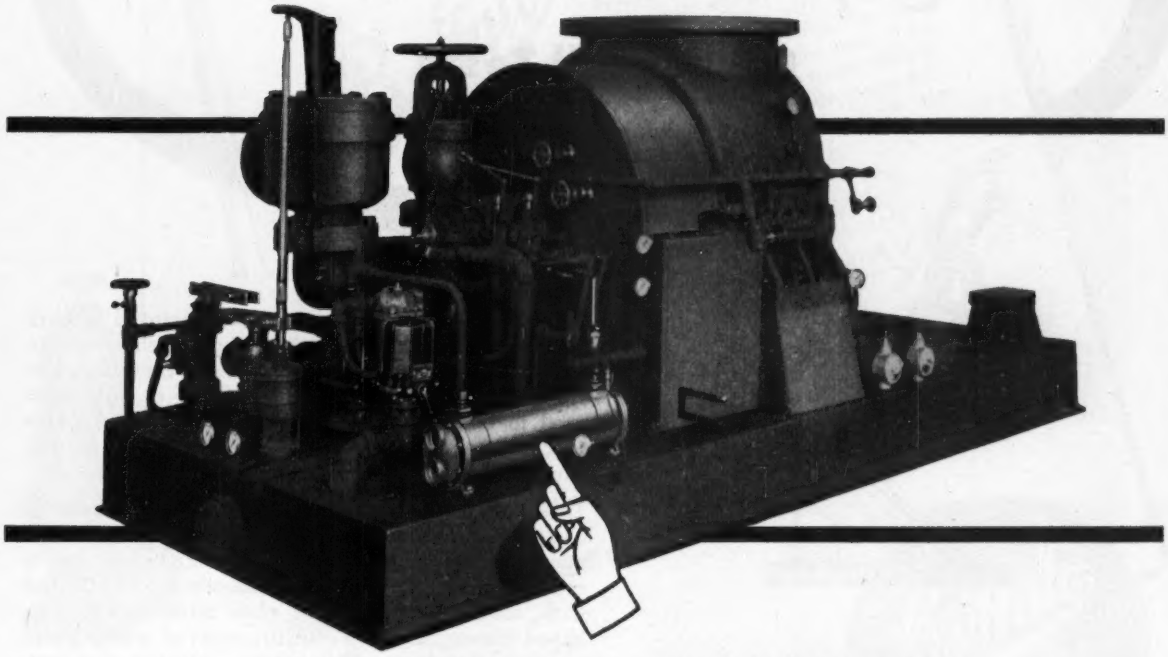
Here's a perfect example of the dependability of Kinney Vacuum Pumps. These Brookhaven Pumps have been operating continuously for over a year and have required only one oil change during this period.

Kinney High Vacuum Pumps are serving all types of industries today: electronics, electrical, pharmaceutical, food, metallurgical, research, refrigeration, and many others. Kinney engineers have a wealth of practical, on-the-job experience . . . ready to serve you. Why not call in your nearby Kinney vacuum engineer today? Kinney Manufacturing Company, 3551 Washington St., Boston 30, Mass. — manufacturers of vacuum and liquid pumps. Representatives in New York, Chicago, Detroit, Cleveland, Atlanta, Houston, New Orleans, Charleston (W. Va.), Philadelphia, Pittsburgh, Los Angeles, San Francisco, Seattle, and foreign countries.

Kinney

SUBSIDIARY OF THE NEW YORK AIR BRAKE CO.

keeping oil temperature at proper operating level in this Terry Turbine



A ROSS EXCHANGER

Driving a centrifugal compressor in demanding refinery service, this Terry Multi-Stage Turbine is rated 2700 hp at 8500 rpm. To provide oil temperature control for the unit's variable speed oil relay governor, main journal and thrust bearings, The Terry Steam Turbine Company factory-installed a Ross Type BCF Exchanger. An adequate supply of dependably cooled lube oil, at correct viscosity, is thus assured at all times.

Regularly written into specifications where high thermal efficiency and extreme ruggedness are of prime importance, Ross Exchangers are widely preferred throughout the oil and gas industry as standard components of engines, compressors, speed increasers, transformers and hydraulic equipment.

Pre-engineered, fully standardized, all copper and copper alloy Ross Type BCF Exchangers are stocked in a wide range of sizes to meet most requirements . . . *promptly*.

Detailed information is in Bulletin 1.1K5. Write.

KEWANEE-ROSS CORPORATION
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
1411 WEST AVENUE • BUFFALO 13, N. Y.
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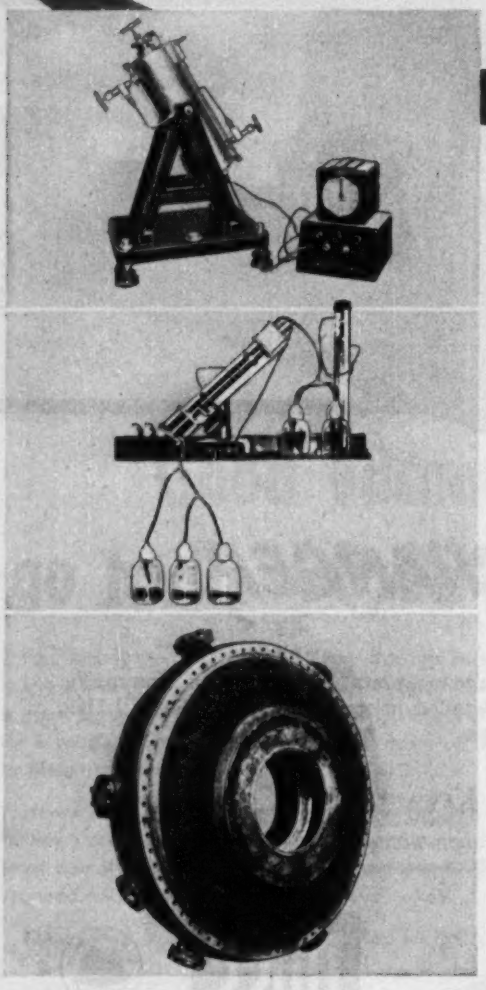
From Crude—to Plasma—to MSG

Carpenter Stainless Tubing

Passes All Tests



In the column at the left you see pictured a high pressure Viscosimeter used for field testing in the petroleum industry; a Blood Plasma Sterilizer that speeds processing of that vital fluid; a Calandria used to extract highly corrosive Glutamic Acid in process of making Monosodium Glutamate to add savor to food.

These pieces of equipment have one thing in common—Carpenter Stainless Tubing—and for each one Carpenter tubing was specified for a *different set* of reasons. They included extra smoothness of I.D. and O.D., unusual concentricity, close adherence to published tolerances, good ductility, ease of working and corrosion resistance. One reason, however, was common to all specifications—*unvarying quality*—from piece to piece, order to order.

In short, the manufacturers of these and many other diverse types of processing equipment know that there *is* a difference in stainless tubing—and Carpenter makes that difference. Why not get the cost-saving advantages of Carpenter's all-round service satisfaction the next time you need stainless tubing?

Call your nearest Carpenter representative for prompt service on your requirements *plus* help in solving design, engineering or fabricating problems.

The Carpenter Steel Company, Alloy Tube Division, Union, N. J.
Branch Offices: Atlanta Chicago Pittsburgh Houston Newark San Francisco

Export Dept.: The Carpenter Steel Co., Port Washington, N.Y. "CARSTEELCO"

Carpenter

STAINLESS TUBING & PIPE

Analysis → Tolerance → Finish →

- guaranteed on every shipment

MEMO TO COST-CONSCIOUS PUMP BUYERS:

The centrifugal pump to handle your job to satisfaction and at lowest power and upkeep cost is shown or described on this page.

"Buffalo"

Pumps are not built to sell cheaply, but to operate cheaply. That is where pump savings are made. May we suggest that you and your staff write us for engineering bulletins on any pumps you need. Then look into the long-life features like oversize "Buffalo" bearings, shafts and stuffing boxes. See the accessibility of all parts, the high efficiency impeller design. You'll see why "Buffalo" Pumps save money!

BUFFALO PUMPS, INC.
BUFFALO, NEW YORK

Subsidiary of Buffalo Forge Co. Canada Pumps, Ltd., Kitchener, Ont.

...and DID YOU KNOW that you can get a "Buffalo" Fan of the exact size and type you want — for ventilation, blowing, exhausting, draft, air conditioning supply. "Buffalo" has been First For Fans for 75 years. You're safe in specifying "Buffalo" for your air handling needs!

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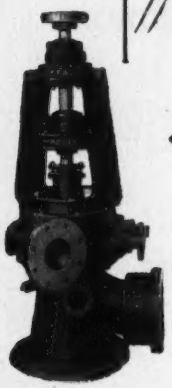
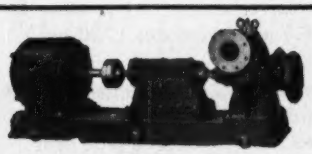
501 BROADWAY BUFFALO, N.Y.
Publishers of "Fan Engineering" Handbook
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

"Buffalo" PUMPS

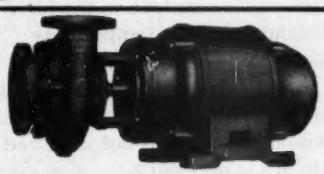


NON-CLOGGING SEWAGE PUMPS
For trouble-free sludge circulation, agitation and removal. Vertical or horizontal models. Request Bulletin 964-G.

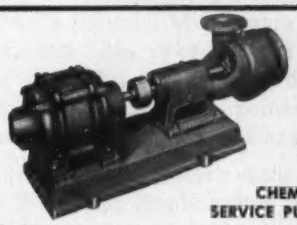
SUMP PUMPS
Complete units ready to install. No stuffing boxes required. Ball bearing thrust and enclosed shaft.
Bulletin 963-F.



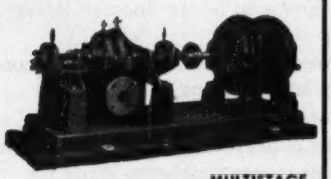
PAPER STOCK PUMPS
A pump for every liquid, consistency and head. Non-clogging enclosed impellers retain initial efficiency. Mill-proven for many years. Bulletin 953.



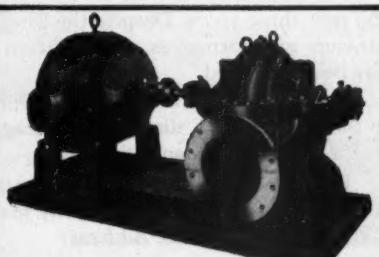
CLOSE-COUPLED PUMPS FOR ALLOY CONSTRUCTION
Compact, sturdy, easily installed. Shafts in permanent alignment. Bulletin 975.



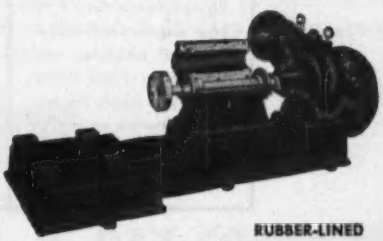
CHEMICAL SERVICE PUMPS
Suitable for construction in most machineable alloys. Full ball bearing, single suction. Bulletin 982.



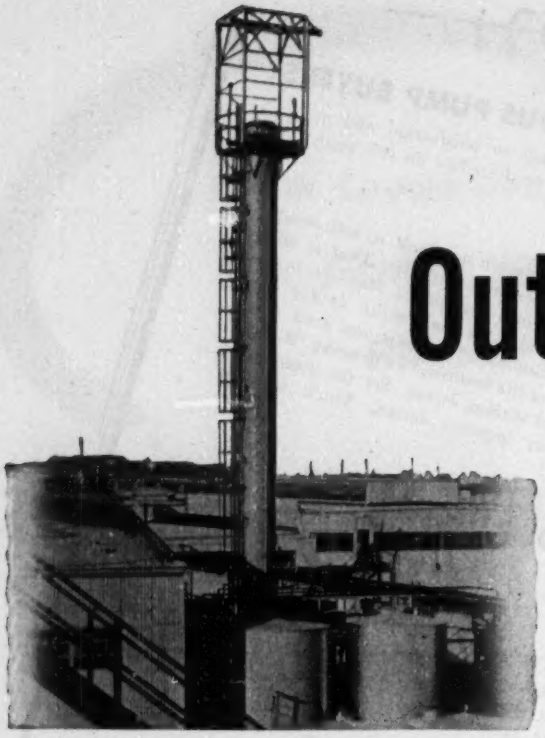
MULTISTAGE CLEAR WATER PUMPS
for pressures up to 500 psi. Rugged, efficient, popular boiler feed pumps. Bulletin 980. "Buffalo" also manufactures automatic condensate pump and receiver units.



DOUBLE SUCTION CLEAR WATER PUMPS
are hydraulically balanced and of finest obtainable construction. Bulletin 955.



RUBBER-LINED
"Buffalo" Rubber-Lined Pumps handle a wide variety of acids, caustics and liquids containing abrasives. All pump parts contacting liquid are covered with the proper grade of rubber. Bulletin 953.



Outstanding

FOR CORROSION RESISTANCE AND STABLE FATTY ACID PRODUCTION

. . . Inconel-lined fat-splitting tower at Swift & Company's Technical Products plant, Hammond, Indiana

Design engineers at Swift & Co., wanted two things from their new fat-splitting tower in Hammond, Indiana. And both required a corrosion-resisting construction material.

First, they wanted light colored fatty acids with good color and oxidation stability.

Secondly, they wanted a tower that would successfully stand up against the severe conditions of temperature, pressure and corrosives involved.

That's why the engineers lined their tower with Inconel®.

Inconel is resistant to the highly corrosive fat-splitting process. It withstands the high temperature (500°F.) and pressures (700 psi.) required for efficient operation.

And since the expansion coefficient of Inconel is very close to that of steel, Inconel lends itself well to lined and clad construction. Since its corrosion resistance is not impaired by welding, no subsequent heat treatment is necessary.

All in all, Inconel proves itself ideal for fat-splitting tower applications.

Swift's 70-ft.-high Inconel-lined tower has been producing material with average acid number of 197... with efficiencies about 99% for the past three years. Despite the severe conditions of temperature, pressure and corrosives, no significant corrosion of the Inconel lining has been observed.

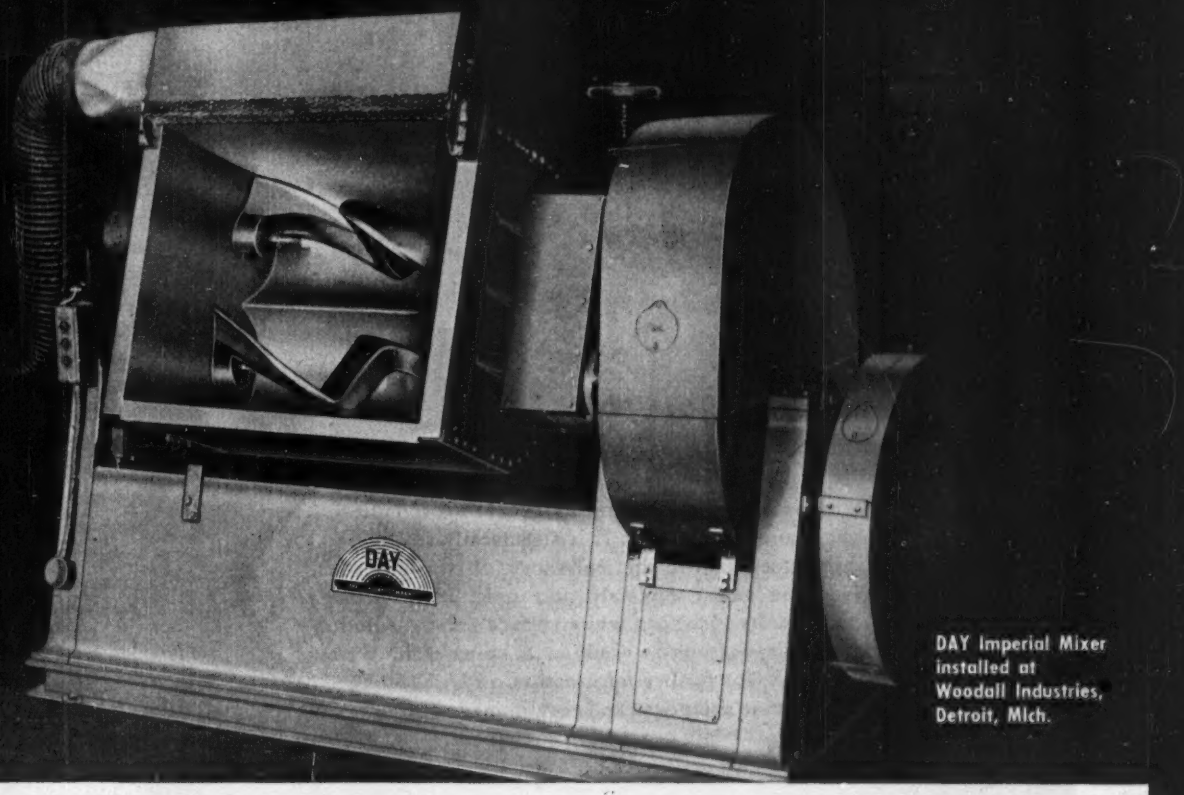
Inconel, Monel® and Nickel equipment have excellent service records in the manufacture, distillation, storage and handling of fatty acids and in their subsequent utilization.

Perhaps Inconel – or one of the other Nickel Alloys offers the solution to your corrosion or product purity maintenance problems. Write for additional information. Address:

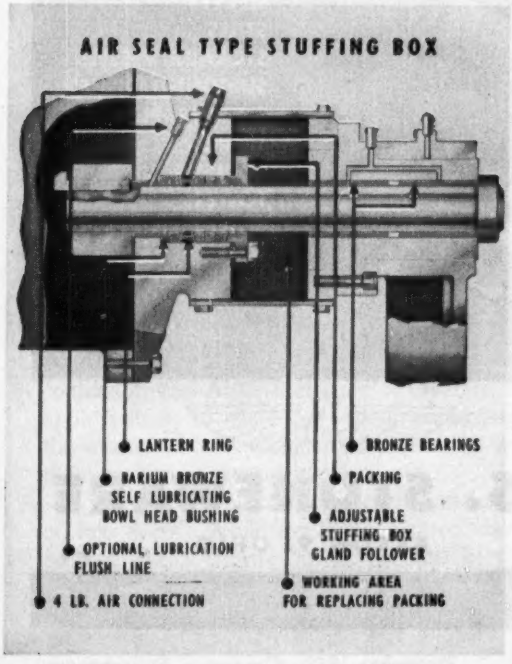
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

It is advisable to place equipment orders with your suppliers well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill.

DAY means longer life span



DAY Imperial Mixer installed at Woodall Industries, Detroit, Mich.



✻ Built for heavy duty, engineered for precision . . . this combination makes DAY's Imperial Mixer extra long-lasting and serviceable. It has been re-engineered with major advances in design, assuring fast, thorough dispersion mixing of heavy plastics and colors in paints and inks, as well as sludge reclamation in paints and enamels.

Shown at left is one of the Imperial Mixer's most valuable features . . . the Air Seal Type Stuffing Box. Pneumatic pressure at 4-10 lbs. protects your product against contamination by lubricants and guards bearings from damage by abrasive mixtures. CO_2 may be substituted for air. For details, call your nearest J. H. Day field engineer or write for Bulletin 600.

FOUNDED 1887

when you buy **DAY** *you buy dependability*

THE J. H. DAY COMPANY

INCORPORATED

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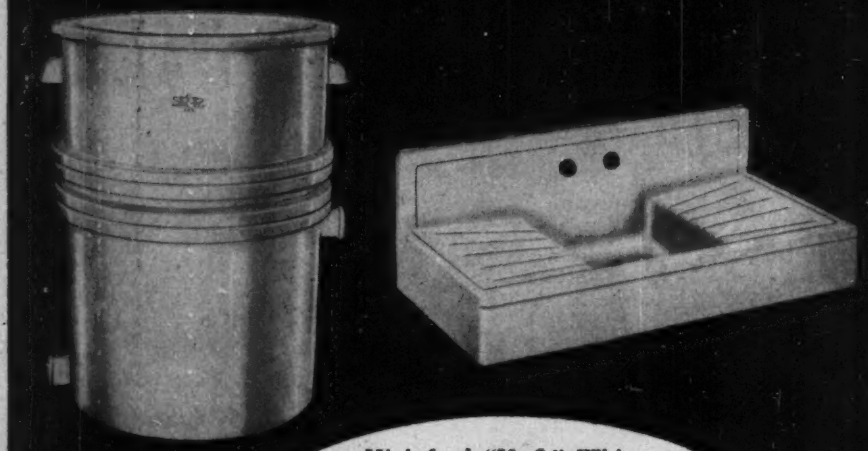
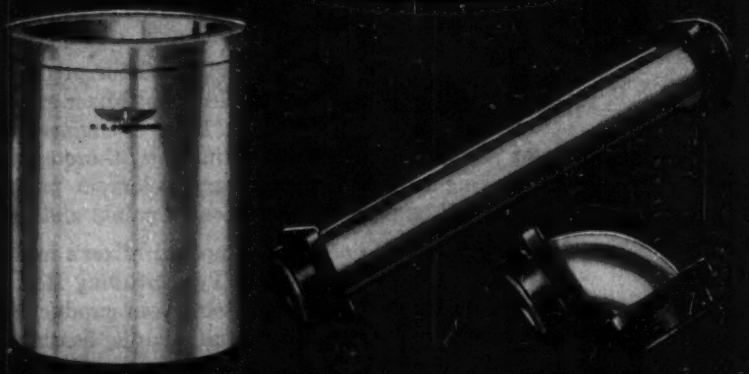
PRODUCERS OF QUALITY EQUIPMENT FOR BAKING • PAINT & VARNISH • CHEMICAL FOOD • CANDY • RUBBER • CERAMICS • PHARMACEUTICALS • COSMETICS • SOAP PAPER & PULP • MILK PRODUCTS • EXPLOSIVES • SUGAR • OTHER MAJOR INDUSTRIES



High-fired "U. S." White Chemical Porcelain is the finest made. It is inert to all chemicals except hydrofluoric acid and hot caustics. It is structurally strong and highly resistant to thermal shock. It is non-porous, iron-free and completely non-toxic. It is virtually ageless. Its gleaming white surface assures solution visibility—cleans as easily as a china dish. Write today, for further information on U. S. Stoneware's standard and custom-made porcelain processing equipment.



ACID ELEVATORS
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PIPE AND FITTINGS
POTS, PUMPS
PUMP PARTS
ROLLS
SCRUBBERS
SINKS
SLEEVES
STILLS
STORAGE VESSELS
SUBLIMING DISHES
SUPPORT PLATES
TANKS
TOURILLS
TOWERS
TOWER SECTIONS
VALVES, VATS

PROCESS EQUIPMENT DIVISION

U. S. STONEWARE
AKRON 9, OHIO

THE Chementator®

Prepared under the direction of Joseph A. O'Connor, News Editor

• Acetic acid is now being produced from neutral sulfite blowdown liquor in a pilot plant at Virginia Polytechnic Institute. After the best method of operation has been determined, a larger plant will be built to explore the economics of producing acetic from semi-chemical liquor.

• Monsanto and National Research Corp. are seeking a government loan for construction of a plant to produce low-cost titanium.

First big U. S. atomic power plant

Moving to harness atomic energy for production of industrial power, the Atomic Energy Commission will construct the nation's first large atomic power reactor. Significantly, it will be a single-purpose plant, producing power but no plutonium.

It will produce at least 60,000 kw. and probably far more. At a cost that may come close to $70 million it will be built for the government by Westinghouse near one of AEC's gaseous diffusion plants. One of these gaseous diffusion plants is at Oak Ridge, Tenn., another is partly built at Paducah, Ky., and a third is under construction near Portsmouth, Ohio.

Since it will be near a gaseous diffusion plant, the power produced by the new reactor will not be sold to consumers or private industry but will help to supply the power requirements of the diffusion plant.

Heat energy from the atomic reactor will produce steam, which will be run through turbines to generate electricity.

Design for the new reactor is based on that of propulsion power reactors built for the Navy, and Rear Admiral Hyman G. Rickover, with experience in naval atomic power, will head the AEC's power project.

But the AEC is not clinging to this particular design. "In the immediate future," says Thomas E. Murray of AEC, "we expect to propose the construction of different types of reactors that will explore promising avenues of approach to practical nuclear power."

While the government will finance this first large atomic power plant, with Westinghouse the principal contractor, the AEC, according to Murray, will call upon industry to invest risk capital in the building of the steam and turbine parts of the plant, as well as in the operation of the entire plant.

The plant is expected to be in operation in three or four years. While eventually atomic energy may produce cheap electric power, the cost of electricity from this first atomic plant will be higher than from present conventional power plants.

In deciding to let Westinghouse go ahead with a single-purpose plant producing only power, the AEC apparently turned down a proposal by General Electric to build a dual-purpose plant for the government at Hanford, Wash., to produce power and plutonium.

What GE proposed, but never officially presented to the AEC, was to construct an atomic power plant at Hanford to produce plutonium for the government and at the same time generate enough power to run the Hanford plant with an excess to be fed to the power-hungry Northwest. The plant most likely would have cost over $100 million. And to meet Hanford's requirements it would have to generate more than 200,000 kw. Best guess is that it would be a water-cooled graphite-moderated reactor.

Besides the high price tag on the proposed GE plant, the government shied away from the idea because AEC believes it already has enough plutonium production lined up to meet its own nuclear requirements. And AEC had earlier turned down a similar proposition by Monsanto to build a dual-purpose plant because it wasn't sure the venture would provide the technological knowledge it wanted for the design of a power reactor.

Uranium by alkaline pressure leaching

A process has been developed in the laboratory, reports Frank A. Forward, metallurgical engineer of the University of British Columbia, for getting uranium from its ores by alkaline pressure leaching.

In this process, the ore, which contains uranium as pitchblende and also has a high content of limestone, is ground, mixed with sodium carbonate solution and charged to continuous autoclaves.

These autoclaves are operated with compressed air at about 100 psi. The pitchblende, oxidized by air, is dissolved. Silica, limestone, iron and other gangue materials are discarded.

(*Continued on page 106*)

Next, the uranium solution is placed in a second series of autoclaves operating under hydrogen pressure with a small amount of nickel catalyst. Uranium is rapidly precipitated as high-purity uranium oxide. The sodium carbonate solution, unaffected by the precipitation, is recycled.

No tax on sulfur from sour gas

District Judge Jack Roberts has ruled that a present Texas tax law is not broad enough to cover sulfur extracted from residue gas. Roberts ruled in the 126th District Court in Austin, Tex., in a tax protest case brought by Phillips Chemical.

Phillips had sued for recovery of $63,903 in taxes paid under protest since 1952 on sulfur produced in two Texas plants.

During the manufacture of fertilizer, Phillips extracts sulfur from hydrogen sulfide gas coming from oil and gas wells. Shell, Gulf and Stanolind had likewise been paying the tax under protest, but had not brought suit.

For ceramics, rebirth through research

"Ceramic industry has been changing from its old status as a backward, inefficient, low profit business," declares W. O. Brandt, research director of Gladding, McBean & Co. of Los Angeles, "to a new and modern type of operation combining highly technical mechanical and chemical techniques for production of improved products at lower costs."

When raw materials became poorer and more costly, the ceramic industry met the challenge by improved processing of raw materials, a quickened tempo of mechanization and intensified research to produce new high-quality products.

The ceramic industry was built originally on plentiful supplies of clay, silica, quartzite, feldspar, talc and similar raw materials, usually of high quality. Its operations were based on cheap materials, labor and fuel.

Within the last 20 years, however, the industry has been turned upside down, according to Brandt. It has intensified research as a result of these five major changes: (1) organization of labor, with elimination of wage differentials between clay products and other manufacturing industries; (2) mechanization of the whitewear industry to compete with imports from cheap labor countries; (3) tremendous increases in consumption of the better raw materials for higher quality products, such as refractories; (4) increased costs of utilization of many ceramic products; and (5) larger markets for quality consumer products.

As outstanding developments in whitewares, Brandt points to improved raw materials, mechanization of processes and better designs. In structural clay products for building and construction, he cites new methods of use and reduction in installation costs. In refractories, he emphasizes the beneficiation of raw materials and the development of improved products.

Higher alcohols via sodium reduction

Higher alcohols can now be produced commercially by chemical reduction with sodium, according to Glenn R. Wilson and Ross D. Stevenson of the Detroit research laboratories of Ethyl Corp.

Unlike most other present methods, chemical reduction with sodium can produce higher alcohols from a wide range of raw materials including fatty compounds from animal or vegetable sources, Dr. Wilson says. Moreover, the process yields a greater variety of product alcohols than do most other methods because sodium reduction does not destroy the chemical characteristics of the starting compounds. Added advantages: the process does not require high-pressure equipment or costly catalysts.

The process basically involves reduction of fatty compounds such as tallow, linseed oil and soybean oil through the combined action of metallic sodium and a reducing alcohol.

Until recently, high sodium consumption and the difficulty of recovering the valuable byproduct glycerine from the reaction products prevented wide commercial use. Now, however, the sodium requirement has been greatly lowered by dispersing the sodium in a suitable solvent and by using smaller quantities of a different reducing alcohol. And the glycerine can now be recovered before the reduction reaction.

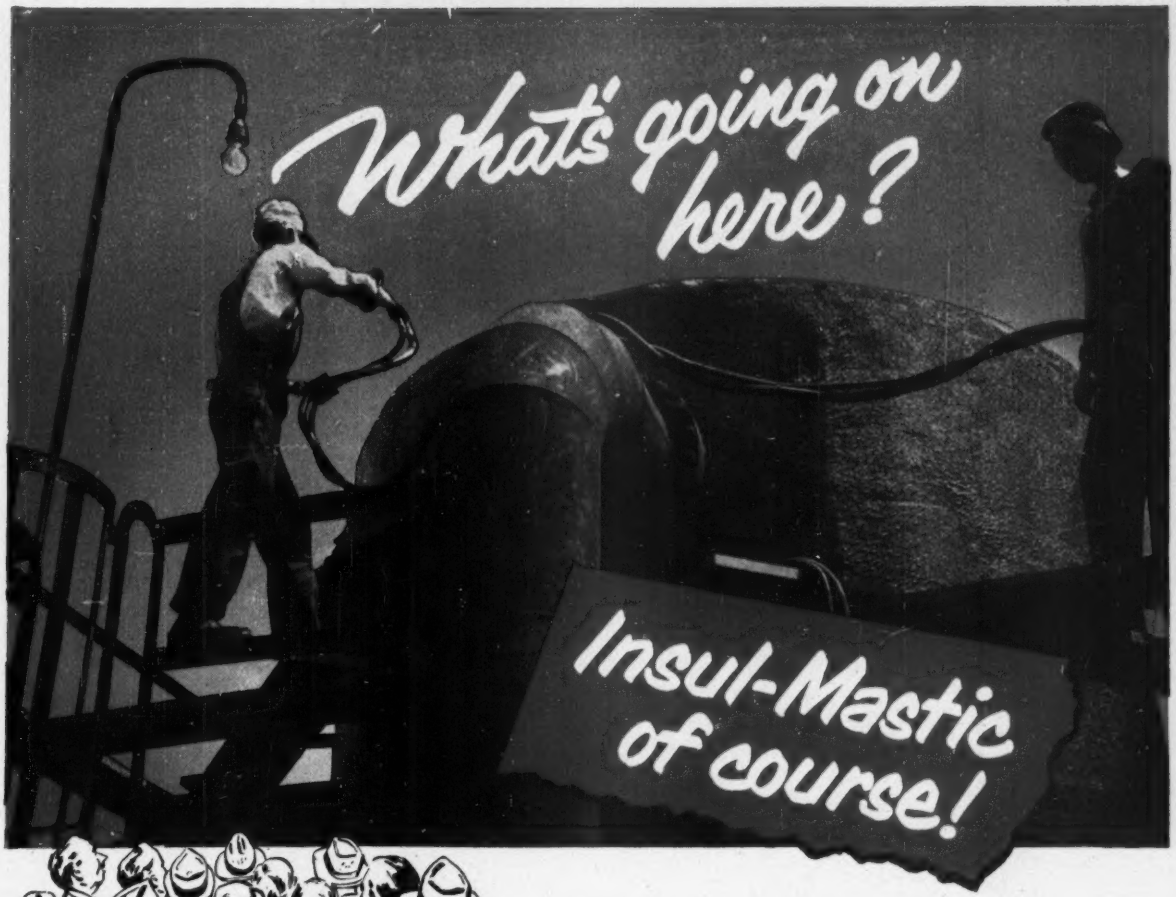
These improvements, plus a new method for freeing metallic sodium of its oxide coating, have made the process attractive to the manufacturer of higher alcohols, according to Dr. Wilson. Higher alcohols, both saturated and unsaturated, are expected to find increasing use in soaps, detergents, paints, lubricants, plastics and waxes.

Uranium from phosphate overlay

When producers of phosphate fertilizers powwowed with officials of AEC, the Department of Commerce and NPA in Washington recently, they learned that the leached zone overlay, currently discarded in the mining of Florida phosphate rock, may become an important new source of byproduct uranium.

AEC has been exploring the possibilities of getting uranium from the leached zone of phosphate material and at the same time increasing the recovery of phosphate fertilizer. Uranium concentrate is being recovered from leached zone phosphatic material for AEC in two small pilot plants that are developing several processes. At least one commercial plant, utilizing one of these process approaches, may be built and operated during 1956.

(*Continued on page* 110)



It's going on over thermal insulation as a vapor and weather barrier

Here's how the Aluminum Ore Company at Bauxite, Arkansas keeps absorbent insulation dry. Membraning cloth is pressed into a light coat of INSUL-MASTIC. Then a heavy coat of INSUL-MASTIC is sprayed over this. That ends the insulation worries for years to come.

The insulation stays dry and efficient beneath its INSUL-MASTIC coat. And while it's dry the tank can't rust.

This *Superior* coating gives lasting protection because of its flexibility and its tough fillers, like asbestos, which absorbs physical abuse, and mica, which reflects harmful rays of the sun. Its large Gilsonite content resists industrial fumes and vapors. Weather won't harm INSUL-MASTIC. It will stand 40° F. below zero or 300° F. above. As for being watertight . . . its moisture vapor transmission rate is only .01 grams per 100 square inches per 24 hours per ⅛ inch.

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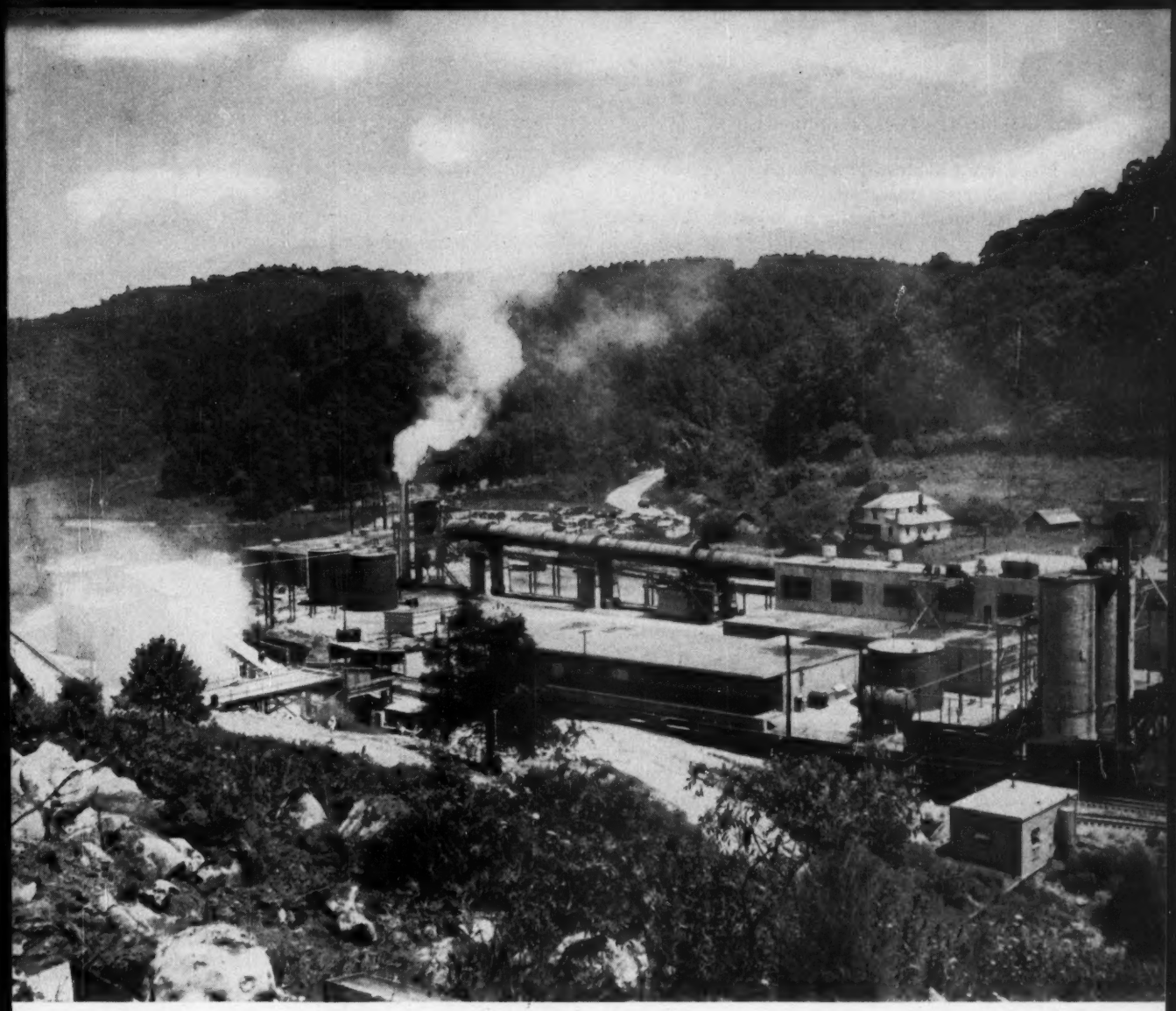
A Salute to

FOOTE MINERAL COMPANY for Doubling the World's Output of Lithium Chemicals

How Foote Company kept industry informed of progress at Sunbright, Va.

BLAW-KNOX



To supply the unprecedented demands for lithium chemicals, Foote is now ready with a plant and a program that will double the productive capacity of the entire industry! This installation at Sunbright, Va., can lay claim to many "firsts" in design, techniques and size. From an engineering standpoint it was a very interesting project . . . one in which Chemical Plants Division participated from original plans, through layout, engineering, procurement and construction.

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San Francisco 5

Since iron and aluminum phosphates are found in the leached zone rock, attainment of the AEC's objective will depend directly on whether the phosphate industry can use the new processes for the economic production of phosphate fertilizers.

Industry representatives were told that, within six months, capital and operating cost estimates and further information on the agronomic value of plant food products manufactured from the leached zone materials will be available. Meantime, producers of phosphate fertilizers, who hesitated to express an immediate opinion at the Washington meeting, will have time to mull over their own ideas on the feasibility of the new processes.

Commercial phosphate rock, of course, has been a source of byproduct uranium since September 1952 in one privately operated production plant, and others are now under construction. Even so, the government wants makers of phosphate fertilizers to consider utilization of the leached zone overlay in any contemplated expansion plans.

Present expansion by the phosphate fertilizer industry, according to NPA, includes construction of 56 new facilities by January 1955, having a production estimated at 1,203,400 short tons of P_2O_5 per year. This breaks down into 13 plants to produce 572,900 short tons of P_2O_5 per year as triple superphosphate; 7 plants to make 171,700 short tons as ammonium phosphates; 11 plants making 173,700 tons as nitraphosphates; 20 turning out 148,600 tons as normal superphosphate; and 8 plants producing 136,500 tons as phosphoric acid and other miscellaneous compounds.

Chlor-alkali springboard for organics

Completing its current expansion, Wyandotte Chemicals Corp. has just put its new chlorine plant on stream at Wyandotte, Mich. The plant can produce 300 tons per day of chlorine.

As a result of the expansion, Wyandotte has increased its output of soda ash by 20 percent and of chlorine by 75 percent.

Wyandotte's increase in chlorine and soda ash capacity will implement its decision to maintain a primary position in these products, according to President Robert B. Semple. Meantime, however, Wyandotte is moving steadily deeper into the production of organics, which account for higher and higher percentages of Wyandotte's total output. Future expansion in organics is anticipated.

Dixie: coming kingpin in chemicals

Within a decade, the South will lead the nation in chemicals. That's the prophecy of Dr. Frank J. Soday, research director of Chemstrand Corp. at Decatur, Ala., and vice president of the Southern Association of Science & Industry.

"The South today produces more than 25 percent of the nation's chemicals," Dr. Soday says, "and within 10 years will be producing more than 50 percent."

Dixie contains one-third of the nation's process industries. Among them: the manufacture of synthetic fibers, fertilizers, pulp and paper, and other operations that employ chemical technology.

Southern capacity for manufacturing pulp and paper is nearing 30,000 tons per day, with 69 huge mills operating or under construction. Georgia Tech and the U.S. Department of Agriculture have contracted for an investigation of methods for producing pinic acid from turpentine. Research aimed at finding new uses for cotton fibers is yielding promising results. Methods are being developed to overcome stream pollution difficulties. Three vital military research units are under construction in the South. And the South has set new records in the production of kaolin, fuller's earth and bauxite.

Advent of chemical industry is accelerating the South's industrial growth. The first decade after World War II is characterized by Dr. A. P. Black of the University of Florida as "the turning point in the development of the South."

Few Southerners themselves are fully aware of the dimensions of the tremendous industrial upsurge and expansion. It is breaking up old patterns of population and agriculture. It is changing the physical face of the Old South. It foreshadows deep-seated economic, social, psychological and political changes.

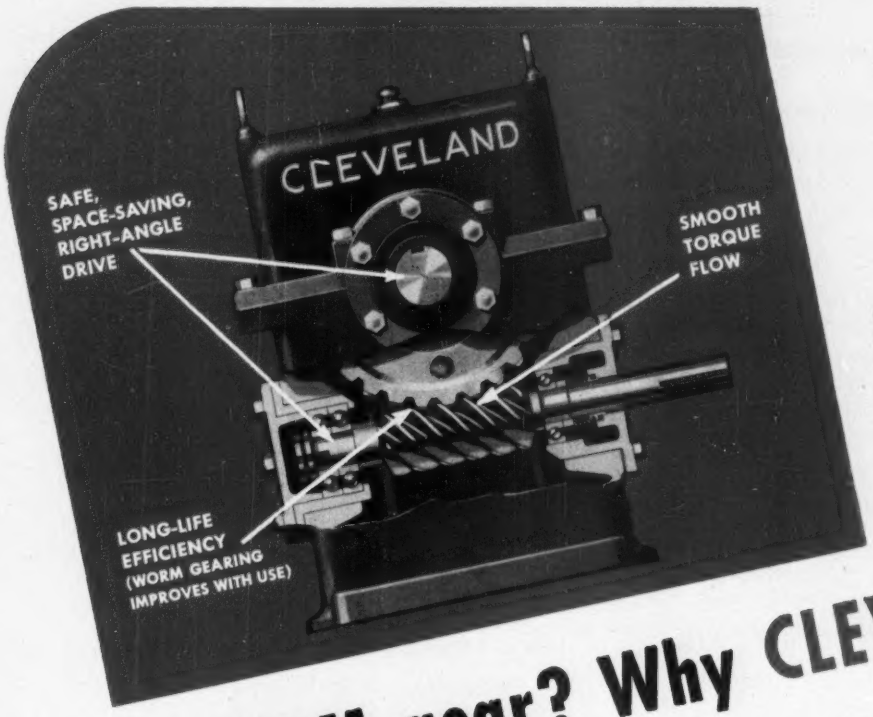
Allied moves ahead in plastics

Exploiting its new beachhead in plastics, Allied Chemical & Dye Corp. is fanning out into production of polyesters, urea-formaldehyde resins, alkyds and vinyl resins. Allied has purchased for cash the $51 million Plaskon Division of Libbey-Owens-Ford. In addition, Allied will produce polyvinyl chloride.

Allied's Barrett Division will take over operation of Plaskon's two Toledo plants. Addition of Plaskon's wide range of plastic molding compounds and resins, including urea-formaldehyde resins, polyesters and alkyds, to Barrett's present line of resins and plasticizers will strengthen Barrett's position in plastics. Barrett is also getting into the vinyl business.

Instead of expanding its plastics operations, Libbey-Owens-Ford decided to sell its Plaskon Division and plow the money from the sale into an intensification of activities in fields more closely integrated with glass, its major product. Expansion by LOF of Plaskon would have required substantial investment in chemical plant and equipment to produce raw materials. Allied is a producer of basic chemical raw materials for the manufacture of plastics and synthetic resins.

(Continued on page 112)



Cutaway shows compact interior design and construction of a typical Cleveland worm gear speed reducer, used in thousands of plants. Clevelands save floor space—are simple to install and maintain. A minimum number of moving parts practically eliminates trouble.

Why WORM gear? Why CLEVELAND?

HERE are some of the inside reasons why Cleveland worm gear speed reducers are specified by many of the leading builders and users of industrial machinery.

• **SAFE, SPACE-SAVING, RIGHT-ANGLE DRIVE**—Clevelands are compact, provide a wide range of reduction speeds. Worm and gear enclosed in sealed housing replace dangerous open gearing, belts and pulleys. Safety always for machine operators and lube men! Gearing runs in oil bath, insures positive lubrication, eliminates oil cans and grease paddles.

• **SMOOTH TORQUE FLOW**—By virtue of the sliding action of worm on gear, a Cleveland transmits power uniformly and smoothly. Constant angular velocity assures positive control of work on driven machine.

• **LONG-LIFE EFFICIENCY**—Experience demonstrates that Cleveland case-hardened worms and nickel-bronze gears actually improve with use. Even operating under continued, severe overloads, danger of sudden failure is remote. Thousands of Clevelands operate for the life of driven machines.

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CLEVELAND
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New paper mill to use semi-chemical process

A $20 million paper mill, to be built by Crossett Cos. at Crossett, Ark., will produce bleached food container board. It will utilize both pine and hardwoods. Daily capacity: 150 tons.

Crossett's kraft mill is now turning out 450 tons of paper daily. Other Crossett mills produce lumber and lumber products, as well as wood chemicals.

The new plant will begin production in about two years, and will employ about 200. It will provide an outlet for hardwood pulp through the use of a neutral sulfite semi-chemical process.

First big phenol plant for West

Monsanto has won the race to become the first big producer of phenol in the West, beating Standard of California, the other entry, by two months. Tank cars are already rolling out of Monsanto's new Avon, Calif., plant, while Standard's nearby Richmond, Calif., plant, which will produce 35 million pounds per year of phenol from cumene, won't be on stream until late in December.

Originally, Monsanto's new plant at Avon wasn't supposed to get into production until the end of January 1954 at the earliest. However, Monsanto engineers, eager to be first in with a new phenol plant, stepped up that timetable, and are now chortling over their victory. They called the start-up "amazingly easy."

The process used is Monsanto's own sulfonation process. While it won't reveal the actual capacity of the new Avon plant, Monsanto is cocksure that it can produce enough phenol to capture "a large share" of the western market.

Chemical plants become more automatic

Chemical plants more modern and more self-sufficient than today's newest structures, with processing operations monitored and controlled by automatic units that could adjust for errors without disrupting production, are envisioned by C. W. Bowden, Jr., chemical industry manager for the Industrial Division of Minneapolis-Honeywell Regulator Co. He foresees new methods, such as servo-mechanism techniques, markedly increasing the efficiency and output of tomorrow's chemical plant.

The servo approach, Bowden explains, would harness a variety of automatic control instruments to maintain the proper relationships between production phases, automatically correcting for errors. Thus a reservoir of goods in process would not be needed to smooth out production lags. This would eliminate many of the huge storage tanks and the stocks of liquids that now comprise two-thirds of a plant's inventory.

These technological advances would increase the worker's productivity, not replace him, according to Bowden, who points out that since 1939 improved technology in the industry has increased the individual worker's annual output from $15,000 in 1939 to about $26,000 today.

Continuous processing methods and broader use of automatic control devices in industry have boosted today's physical volume to three times what it was 15 years ago.

Value of production in the chemical industry in the year ended April 1953 totaled more than $19 billion, as contrasted with less than $4 billion in 1939—a 190 percent increase. And the chemical and petroleum industries purchase 40 percent of all control instruments sold.

Chemical plants will gradually become more and more automatic. For even though many plant designers are using automatic control more effectively than ever before, much costly and time-consuming development and analysis work remains to be done.

Shell molding: rising phenolic market

Improvements in the shell molding process, predicted Monsanto's Edmond S. Bauer to the CMRA at Pocono Manor, Pa., eventually may result in as much as a 50 percent reduction in the amount of phenolic resin required to produce each mold.

Pointing to the foundry as a market for the chemical industry, Bauer forecast a healthy growth for the shell molding process. The trend toward process improvement indicates that eventually the use of resin per mold may be cut in half. Currently, shell molds contain about 6 percent resin by weight.

Shell molding, which used only insignificant quantities of phenolic resin in 1950, chewed up more than 3 million pounds of resin in 1952.

This year, the shell molding process will consume between 8 and 10 million pounds of resin, according to Bauer. By 1957, he predicted, consumption of phenolics by shell molders will exceed 50 million pounds. This compares with the use of only 64 million pounds of phenolic resin in 1952 for the manufacture of thermosetting molding powder.

Plastic pipe industry booms

The plastic pipe industry, according to Bert S. Montell of SPI, has grown phenomenally in the last five years. From only $500,000 in 1948 plastic pipe sales rose to $15 million in 1952. This year producers of polyethylene and extruders of pipe conservatively estimate that sales will approach $30 million. And by 1957 it's expected that plastic pipe sales will reach a highly lucrative annual market of $250 million. Extruded pipe thus provides still another outlet for versatile polyethylene.

(*What's Happening*, turn to page 114)

MAKING BUILDING BLOCKS for Grown-up Boys

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"Genetron" 12	CCl_2F_2
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"Genetron" 100	CH_3-CHF_2
"Genetron" 150	$CH_2{=}CF_2$
"Genetron" 170	$CCl_2{=}CF_2$
"Genetron" 265	$CClF{=}CF_2$
"Genetron" 226	CCl_2F-$CClF_2$
"Genetron" 141	$CHClF_2$
"Genetron" 316	$CClF_2$-$CClF_2$
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■ Today's organic chemists are modern miracle makers. Using molecules like building blocks, they have created plastics . . . pesticides . . . new petroleum products and other wonders. Ahead are many more.

For such capable hands, General Chemical research has developed the "Genetrons*," a unique series of organic fluorine compounds. They run the gamut in physical and chemical properties. They have applications as basic raw materials, intermediates, and as finished products.

For example, several "Genetrons" have present and potential uses as monomers for fluorine-containing polymers: one points the way to a synthetic rubber which remains elastic at sub-zero temperatures, another to industrial plastics capable of withstanding the severest abuse. Still others make possible improved hydraulic brake fluids and superior coatings for electric wire. Some are also being utilized for vital military and scientific purposes, including atomic research.

As finished products, "Genetrons"—such as "Genetron" 12 and "Genetron" 11—are important as basic refrigerants for all types of household, commercial and industrial refrigeration and air conditioning equipment. These and other "Genetrons" are also the dispersants that make possible the vast array of aerosols and pressure-propelled products on today's market.

For these—and countless other thought-provoking applications—"Genetrons" open the way to building new and better products for many producers. Why not investigate their possibilities in *your* program, too!

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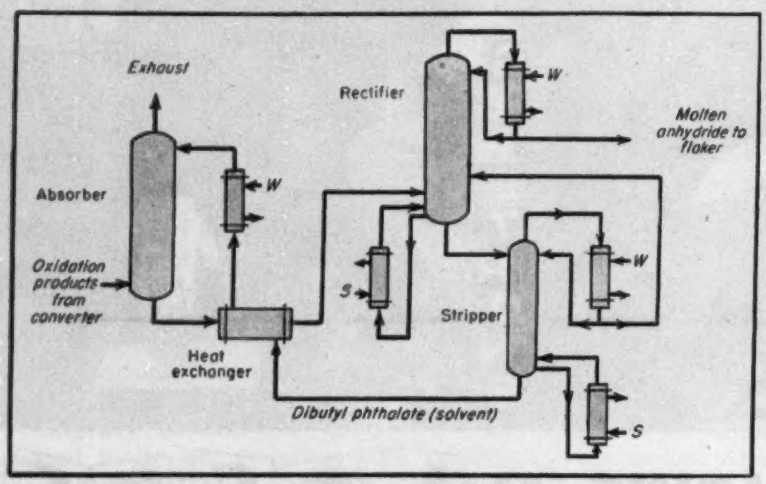
What's Happening



SOLVENT absorption of anhydride in dibutyl phthalate is key to . . .

More Maleic, Lower Cost

New process offers yields as high as 95 percent. Equipment can be used interchangeably for phthalic anhydride to get advantage of large plant's low unit costs.

Rapidly increasing demands by makers of alkyd resins, polyester plastics and soil conditioners are boosting the consumption of maleic anhydride this year to an all-time high. Preliminary estimates range from 30 million to 40 million lb., but either figure is well over last year's 18 million and the previous peak of 24 million in 1951.

Further rapid growth might come via a new process now being offered commercially by Scientific Design Co., New York. Scientific reports that a contract has already been signed for a European plant to use the new process.

▶ **Two in One**—Unique feature of Scientific's process is its interchangeability between maleic anhydride and phthalic anhydride. Different operating conditions are required for the two products, but the same physical plant turns out either one.

Maleic and phthalic anhydrides are close chemical cousins. They are both made by catalytic air oxidation of a suitable starting material—naphthalene or orthoxylene in the case of phthalic, usually benzene in the case of maleic.

Phthalic is, by far, the more popular of the two products. Its 1953 production will approximate 350 million lb. It sells for some 22 c. per lb., compared with maleic's price tag of 32 c.

▶ **Cutting the Cost**—Reduction of this price differential between maleic and phthalic could be the key to greatly expanded consumption of maleic. Present obstacles to a lower price for maleic are the low plant capacities necessitated by the limited markets to date and relatively low yields of product from starting material.

With Scientific's new process, however, a producer can make either maleic or phthalic at will, with both products enjoying the advantages of a large plant and low unit operating costs. And a new method for recovery of anhydride from the converter gases promises to boost the yield of maleic to as high as 95 percent, compared with the 80 to 85 percent yields often found in current practice.

▶ **Absorption in Solvent**—This recovery system, the basis of several pending patent applications and one issued patent (U. S. 2,574,644), uses dibutyl phthalate as a solvent to absorb maleic or phthalic anhydride from the converter gases.

Phthalic anhydride is substantially insoluble in dibutyl phthalate at room temperature, but upon heating to approximately 60 to 125 deg. C. the solubility increases markedly. Solutions containing 10 to 20 percent phthalic, with low vapor pressure of solute over the solution, can be obtained.

On the other hand, maleic anhydride is much more soluble in dibutyl phthalate at temperatures in the range of 10 to 50 deg. C. Accordingly, the anhydride recovery and purification system may be operated within one temperature range for recovery of phthalic and within another range for recovery of maleic, without further modification of the system.

After absorption, the anhydride can be recovered from the phthalate by reduced-pressure distillation in a two-column rectifier-stripper system (*see flowsheet*).

The conventional recovery systems for phthalic and maleic anhydrides are quite different. The former is recovered in reversing condensers or, in older plants, in large air-cooled

in Chemical Engineering

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"barns." The latter is usually removed from the converter gases by scrubbing with water, followed by reheating to convert maleic acid to the anhydride.

▶ **Reaction System**—While Scientific hasn't found a good single catalyst which could make either phthalic or maleic anhydride, it has done the next best thing—developed rugged specific catalysts which can be readily removed and replaced.

The conditions which favor optimum yields of maleic anhydride aren't identical with those for phthalic. Nevertheless, reactors can be designed to use either catalyst and to remove heat of reaction at various temperature levels.

The system is flexible, also, as to starting materials. Maleic anhydride can be made from toluene, butadiene, cyclopentadiene and cyclohexene, in addition to the customary benzene. Phthalic anhydride can be made from naphthalene or orthoxylene.

▶ **Manifold Activities**—The new process, representing six years of laboratory, pilot plant and engineering work by Scientific Design, is only one facet of the work of this comparatively young, enterprising organization, which specializes in chemical plant design and process development. Additional SD processes developed and offered commercially include those for the manufacture of ethylene oxide, citric acid, polyvinyl chloride, antibiotics, styrene, cumene and terephthalic acid. The first four of these have already been proved on a commercial scale in Europe.

Scientific is also handling some sizeable engineering design projects for leading chemical producers, some of which are based on SD's own processes. One just recently announced is an ethylene purification project for Spencer Chemical Co., Orange, Tex., which will be virtually next door to another SD project at Orange, an Allied Chemical & Dye plant for ethylene oxide and glycol, diethylene glycol and triethylene glycol.

Another major engineering project is a mono and polyvinyl chloride plant for General Tire & Rubber Co. at Ashtabula, Ohio. Plants for cumene and chlorinated solvents for other major chemical producers are also in progress.

Monsanto Goes Ahead With Probe of Atomic Power

Although Union Electric Co. is no longer a partner, Monsanto Chemical Co. is continuing its investigation of atomic power for the Atomic Energy Commission. The two St. Louis companies were authorized by the AEC in June 1951 to explore at their own expense the possibility of producing power and plutonium in a nuclear reactor owned and operated by private industry.

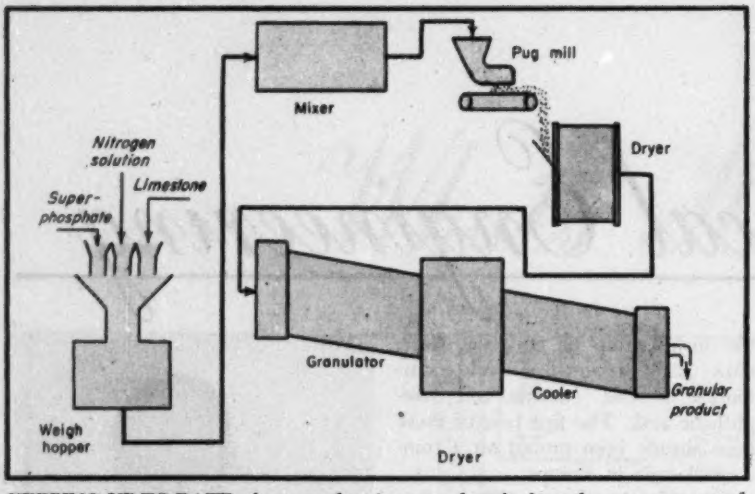
The initial phase of the project was completed under joint sponsorship by Union Electric and Monsanto. Results showed that a reactor of the sodium-cooled graphite-moderated type has promise. Preliminary designs also were developed. Monsanto has accepted an extension of the original agreement with AEC.

MCA's Foster to Speak at Carbide Award Dinner

President William C. Foster of the Manufacturing Chemists' Association will be the principal speaker at the award dinner on Wednesday evening, December 2, at the Bellevue-Stratford Hotel in Philadelphia when Carbide & Carbon Chemicals Co. receives the 1953 Award for Chemical Engineering Achievement. His topic: "The Single Road to Security and Abundance."

Before becoming president of MCA, Foster had served as Under Secretary of Commerce of the United States. He has also been ECA Administrator and Deputy Secretary of Defense.

This will be the twelfth time that award, sponsored by *Chemical Engineering*, has been bestowed on an organization for an outstanding achievement in chemical engineering. The 1953 award goes to Carbide & Carbon Chemicals Co., a division of Union Carbide & Carbon Corp., for its development of coal hydrogenation. The presentation will be made at a subscription dinner in the main ballroom of the Bellevue-Stratford. The 24th Chemical Exposition will be held in Philadelphia during the same week.



KEEPING UP-TO-DATE when a product improves doesn't always have to mean spending a fortune on new equipment to make it. Proof:

Mixing Plant Goes Granular

Here's how a small, progressive fertilizer mixing outfit converted its plant, at minimum cost, to produce a superior product.

A dilemma facing many of the 100 or so producers of complete mixed fertilizers has been neatly sidestepped by Eastern States Farmers' Exchange at its Wilmington, Del. plant.

▶**Better Product**—Encouraged by the U. S. Department of Agriculture's favorable reports, farmers are beginning to demand their fertilizer in granulated form. It's dustless, can be kept without caking, does not deteriorate in seasonal storage. Granular fertilizer can be spread on windy days, is especially good for airplane distribution, and does not wash down below the roots as do pulverized fertilizers. It allows the manufacturer to spread out operations over many months, instead of running two or three months a year to meet peak demands.

▶**But Less Ouput**—But the producer, on the other hand, has usually tried to steer clear of granulation—for two reasons: (1) he can turn out only one-third to one-half as much product per shift; and (2) granulation equipment is costly and requires heavy maintenance.

Nevertheless, the farmers, partly with their willingness to pay more ($1 to $3 per ton) for granulated fertilizer, are gradually forcing the industry to come around.

Eastern States (a farmers' cooperative) has met the cost problem by converting an established mixing plant. Not only were conversion costs kept to a minimum but, because the new process allows much better ammoniation rates to be attained, Eastern States has been able to supply the granulated product to its members at no increase in price.

About 2½ years ago, Dr. Joseph Chucka, Eastern States' director of research (located at the association's home office in West Springfield, Mass.) got together with John Hardesty of USDA's Fertilizer Research Division. (Hardesty has pioneered fertilizer granulation in the U. S., has numerous publications to his credit.) With USDA's help, Eastern States set out to convert its Delaware mixing plant to granulation at minimum cost consistent with efficient operation. The mixer was changed, a pug mill was installed to serve as feeder to the rotary dryer, and the dryer was converted to a granulator-dryer.

Here's how the converted plant operates:

▶**Batch Mixing**—First, superphosphate, potash, nitrogen solution and pulverized limestone (no conditioner is used at this plant) are weighed out to form one-ton batches on a four-minute cycle. From the weigh hopper, the batch goes to the mixer. Moisture content of the mix is about 10 percent (including added water).

▶**Home-made Granulator**—The material comes out of the mixer at about 200 deg. F. and drops to a pug mill which serves as a feeder for the dryer. The dryer is simply a rotating shell 6 ft. dia. by 24 ft. long, with the flights cut out for the first 6 ft. of length so that this portion serves only as a granulator. The shell runs at 6 rpm.

After granulation, the flights pick up the material, and with the help of a countercurrent flame, the material is dried so that final moisture content is about 2.5 percent. After drying, the cooler brings the final product temperature down to 110-115 deg. F.

No attempt is made to regulate particle size, although David Conrad, plant manager, is considering installation of a grinder to get the larger particles down to 14 mesh. This would give higher ammoniation rates, but probably would not improve granulation to an appreciable degree, according to Conrad. The process, at present, gives a homogeneous product of uniform size (90 percent on a 35-mesh screen, almost all through 14 mesh).

Capacity of the plant is 15 tons/hr. Four men operate a single, 8-hr. shift.

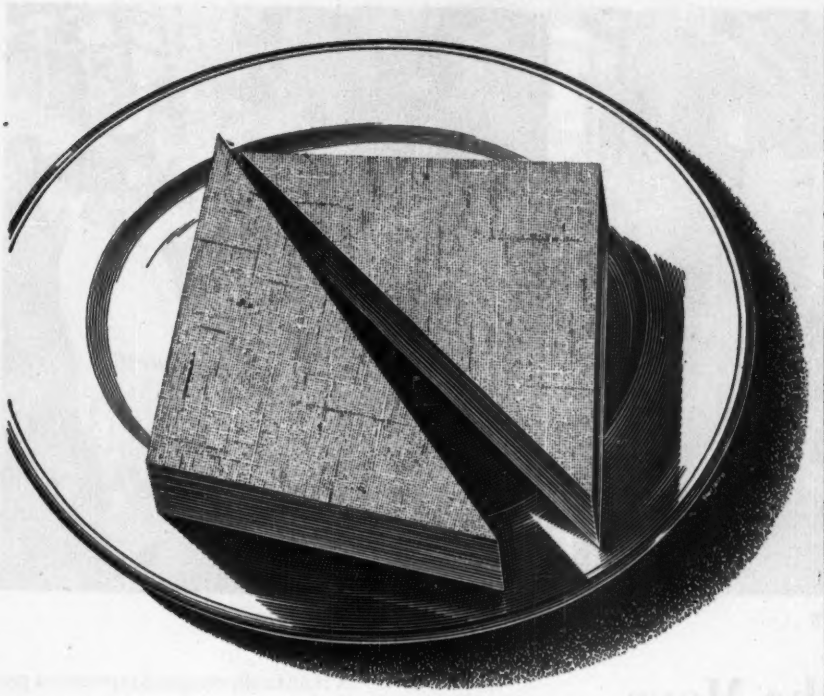
Eastern States is trying out a newer granulator-mixer at its Cambridge, Mass. plant, hopes eventually to install it as a continuous mixer at the Wilmington plant.

Insoluble Sulfur Plant To Use Improved Process

A new $1 million plant, under construction at Monongahela, Pa., by Stauffer Chemical Co. will produce insoluble sulfur. Demand for insoluble sulfur, largely from rubber manufacturers, resulted in Stauffer's decision to expand capacity.

The new plant will utilize a process developed and improved by Stauffer research. It is slated for initial production in May 1954. Stauffer's engineering department is in charge of construction.

Insoluble sulfur is currently produced in two other Stauffer plants at Richmond, Calif., and Chauncey, N. Y. Stauffer also has a large carbon bisulfide plant at Monongahela, which adjoins the site of the new facilities.



Ever see a Plastic "Sandwich"?

The chances are you have, for plastic laminates — plain and patterned — are used extensively today in both homes and business establishments. You'll find them in table, desk and counter tops . . . in walls and wainscots . . . in wash rooms and elevators. They're not harmed by boiling water, alcohol, cleaning acids or alkalies . . . wipe clean with a damp cloth . . . keep their good looks indefinitely.

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Uses of RCI Products

CANVAS, PAPER AND GLASS CLOTH LAMINATES: PLYOPHEN cresol, phenolic and resorcinol-formaldehyde resins and varnishes; RCI polyester resins.

CARBON PAPER: RCI inorganic chemical pigment colors.

CASTINGS: FOUNDREZ powdered phenolic resins (for the shell molding process); FOUNDREZ liquid phenolic resins and FOUNDREZ core oils (for core binders).

CHEWING GUM: SYNTHE-COPAL ester gums.

FURNITURE, PLYWOOD, FLOORING, HARDBOARD AND CHIPBOARD: HYDROPHEN phenolic glues; PLYACIEN protein glues; PLYAMINE urea-formaldehyde glues; PLYOPHEN phenolic and resorcinol-formaldehyde glues.

LEATHER: BECKOSOL alkyd resins (for leather finishes); PLYOPHEN resorcinol-formaldehyde resins, SUPER-BECKACITE pure phenolic resins, SYNTHE-COPAL ester gums (for leather adhesives).

LINOLEUM: BECKOSOL alkyd resins and PENTACITE pentaerythritol resins (for linoleum coatings); RCI inorganic chemical pigment colors.

PAINTS, VARNISHES AND LACQUERS: BECKACITE (1) fumaric, (2) maleic and (3) modified phenolic resins; BECKAMINE urea-formaldehyde resins; BECKOLIN synthetic oils; BECKOPOL modified phenolic resins; BECKOSOL (1) phenolated, (2) phthalic-free, (3) rosin modified, (4) pure drying and (5) pure non-drying alkyd resins; KOPOL processed Congo copals; PENTACITE pentaerythritol resins; STYRESOL styrenated alkyd resins; SUPER-BECKACITE pure phenolic resins; SYNTHE-COPAL ester gums; WALLKYD pure drying alkyd resins (for alkyd flat wall vehicles); WALLPOL vinyl-type copolymer latex emulsions (for latex flat wall coatings); RCI inorganic chemical pigment colors.

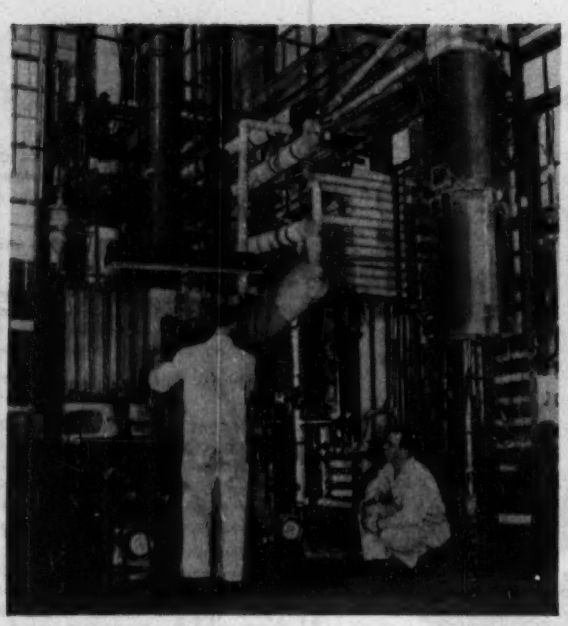
PAPER: BECKAMINE urea-formaldehyde resins (for adding wet strength, improving the wet rub of starch-clay coatings, and waterproofing starch adhesives); RCI inorganic chemical pigment colors (for paper coloring); STYRESOL styrenated alkyd resins (for paper coating).

RUBBER SUNDRIES: PENTACITE pentaerythritol resins; SUPER-BECKACITE pure phenolic resins; SYNTHE-COPAL ester gums (for rubber adhesives).

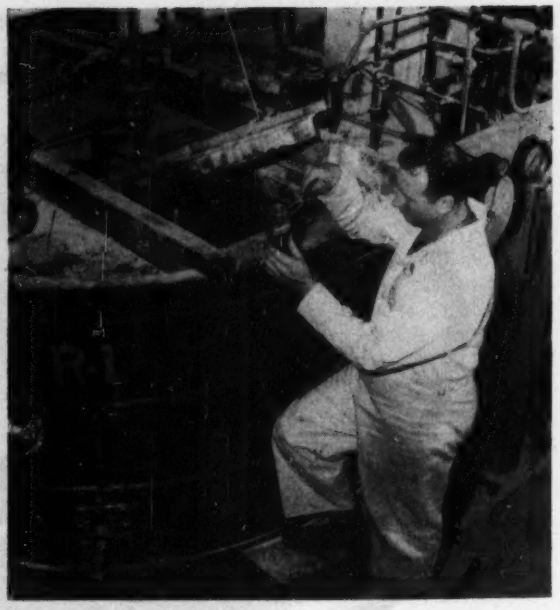
SANDPAPER: PLYOPHEN resorcinol-formaldehyde glues.

WAXES AND POLISHES: BECKACITE modified phenolic and maleic resins; SUPER-BECKACITE pure phenolic resins; SYNTHE-COPAL ester gums.

RCI



IN DESIGN OF EXPERIMENTS . . .



IN QUALITY CONTROL . . .

Statistics on the Move

Statistical methods are being used more and more in the process industries. Chemical engineers are finding them valuable for both research and production problems.

Chemical engineers were conversing in a strange language recently in Philadelphia's Convention Hall. "Frequency curves," "standard deviation," "factorial experiment design" and similar terms were tossed around by people who normally discuss problems in terms of Reynolds numbers or tray efficiencies.

Occasion for all this was the seventh annual convention of the American Society for Quality Control. The language—statistical. Chemical, pharmaceutical and petroleum companies were well represented at the meeting. The facts all point to the increasing use of statistical methods by the chemical process industries.

Here are some of the companies now applying statistics in chemical work:

• Tennessee Eastman finds statistics useful in the design of plant experiments. Economy of experimentation is a major benefit.

• General Electric uses the techniques of statistical experiment design in its chemical operations. These techniques foster planned rather than shotgun or intuitive research.

• Humble Oil and the Texas Co. use statistics in solving a host of refinery problems, such as blending gasoline stocks or controlling the purity of fractionating tower products.

• Monsanto and Bakelite use statistics in development of testing methods and in plastics evaluation research. Monsanto, for example, reduced the number of experiments in a test development program from 224 to 32 with the aid of statistics.

• Bristol Laboratories controls the quality of a continuous extraction process by applying statistics. The use of quality control charts, in pinpointing trouble spots, increases the yields of acceptable product and reduces processing costs. Side benefits are creation of an awareness of "quality" among plant personnel and an upgrading of sampling and laboratory techniques.

▶ **Design of Experiments**—An important application for statistics—one rapidly gaining ground—is in the field of design of experiments. In the usual "classical" experiment each factor or variable is investigated one at a time. A statistically designed experiment permits study of a number of variables simultaneously.

This new tool helped Tennessee Eastman decide whether the color of a cellulose plastic made from a special cellulose was the same as that obtained in regular production. The regular production run averaged 182.7 color units, with a standard deviation of 21.3. The experimental run averaged 156.8, with a standard deviation of 14.6.

Was there a significant difference between the materials? An analysis using a procedure called the "t-test" showed that there was indeed a difference between the averages. An analysis for variances, called an "F-test," showed that the variation in the regular production was significantly greater than the variation in the experimental process.

▶ **Factorial Design**—General Electric has applied a more complex technique called "factorial experiment design" to a situation involving three variables. The problem was to determine whether there was a significant variation in viscosity between drums of a silicone gum-rubber from a batch, between operators making the test or between types of measuring jars used in the test.

Twenty-seven tests, based on three drums, three operators and three jars, were carried out for a complete facto-

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SOME BASIC STATISTICAL CONCEPTS

Statistics is usually defined as the scientific application of the laws of probability to data. In most cases of interest to the chemical engineer, the data come from production processes or experiments. It's hardly practical to carry out processes or experiments in which all possible variables are completely controlled. Repeated measurements under presumably identical conditions rarely give identical results, owing to chance errors or variations.

Measurements tend to distribute themselves around the average value. The pattern of this distribution can be presented visually by plotting the frequency of occurrence of each value against the value. For an infinite number of measurements the result will be a bell-shaped curve, the so-called frequency or distribution curve.

Applications of statistics are usually based upon the mathematical characteristics of a symmetrical or "normal" frequency curve. Industrial data will seldom produce a "normal" distribution, but the usual deviations are not serious enough to vitiate statistical analyses.

Variance and standard deviation are measures of the dispersion of data. Variance is defined as the sum of the squares of the deviations of a set of random observations from their average divided by one less than the total number of observations. Standard deviation is the square root of the variance.

Quality control methods are based on the idea that product quality data follow a pattern approximating the normal curve. The frequency with which quality test results may fall outside specified limits, due to normal process variations, can be predicted from the characteristics of the normal curve. An excessive number of results that fall outside the limits signifies that the process is going out of control.

Experimental work differs from production operations in that tests can be made with independent variables selected at specified levels. A practical problem arises in deciding whether the measured effects on the dependent variables are significant. Another problem is how much does each variable contribute to the total variance of an experiment.

Statisticians help to solve these problems with such techniques as "design of experiments" and "analysis of variance"—all based on the concepts of the frequency curve and dispersion of data.

rial experiment. An analysis of the data, using the technique of analysis of variance, showed not only the effect of drums, jars and operators on the viscosity results, but also any interacting effects. Interaction produces effects that cannot be traced to drums, jars, or operators alone—Operator A may have a tendency to read high values from Drum 2, while Operator B may have a tendency to read high values from Drum 1.

The complete factorial design represents maximum effort. In some cases this much work may not be justified. Other designs will reduce the work involved, but yield less information.

The factorial experiment, coupled with analysis of variance, is a very powerful tool, but the mathematics and concepts can get involved. Here it becomes a question of education. James H. Davidson of General Electric expresses it this way:

"Most problems involving the design and analysis of a practical experiment require the combined efforts of the experimentor and the statistician. . . . The engineer must know about these activities so that he can cooperate with the people in them to his own advantage. The engineer in industry needs to gain an appreciation of what statistical methods can do for him and a general idea of how they operate, before he can fully use a new member on his team—the statistician."

▶ **Quality Control**—This subject also received much attention at the ASQC meeting. "Quality," in this sense, is the ability of a product to conform to specifications; "control" is simply the business of assuring conformance. Quality control was used with great success during World War II, particularly for the mass production of small metal parts.

The beauty of the method is that charts are obtained showing trends of product quality. If a trend indicates that the process is going out of control, corrective measures can be taken before serious trouble develops. This is contrasted with the inefficient procedure of reprocessing or weeding out defective material from a production lot already produced.

Humble Oil, evidently sold on quality control, described the application of the technique to one of its refinery operations. Control charts, for averages and ranges, on the purity of the product of a fractionating tower, showed that the process was out of control. After an investigation, it turned out that part of the trouble was in the poor accuracy of an analytical method. A team of engineers and statisticians worked out an improved method and explained the principles of quality control to the operating staff. After this, quality control charts showed a greatly improved process. The charts definitely proved themselves when, for a period of 108 hours of production, no adjustments were made to any of the tower controls and no slops were produced.

▶ **Difficulties**—In spite of the efforts of organizations like ASQC, the industrial application of statistical techniques is still in its infancy. "Percentagewise very few of our industries actually engage in practically applying this new tool," says C. E. Hoover of the Perfect Circle Corp., "especially so far as manufacturing processes are concerned."

Why the slow progress? A partial answer is that in applying these techniques, the human relations problems become as important—and sometimes more difficult to handle—then the straight mathematical and engineering problems.

This point was emphasized again and again at Philadelphia. Most chemical plant processes are supervised by technically trained people—but people with little or no understanding of statistics. The language and concepts used by statisticians are "Greek" to the average chemical worker or supervisor. Yet these are the people that make or break a quality control program.

Bristol Laboratories, Humble Oil, Bakelite, all seem convinced of the fact that the people handling the day-to-day details of quality control must thoroughly understand what the program is all about. Humble became interested in statistics about three years ago and, recognizing the educational problem, brought experts to Baytown, Tex., to conduct training courses for its people.

Despite these difficulties, it appears certain that more and more people in the chemical industry are being sold on the use of statistics. The techniques available, when intelligently applied, promise to make important contributions to the reduction of costs and the improvement of operations.

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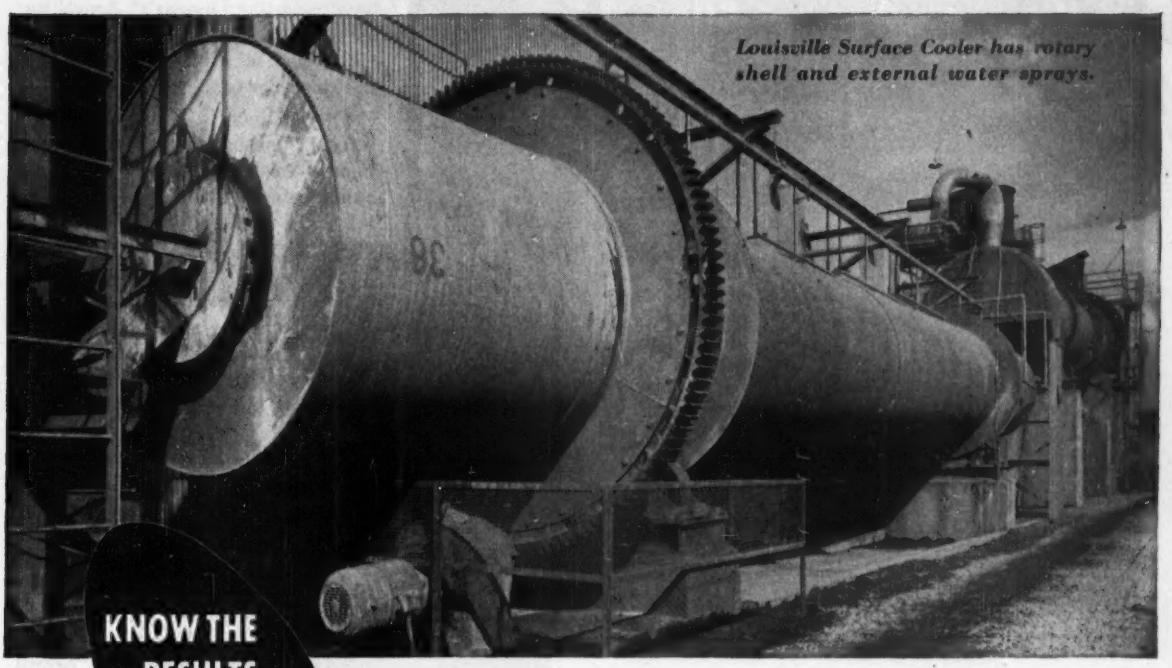

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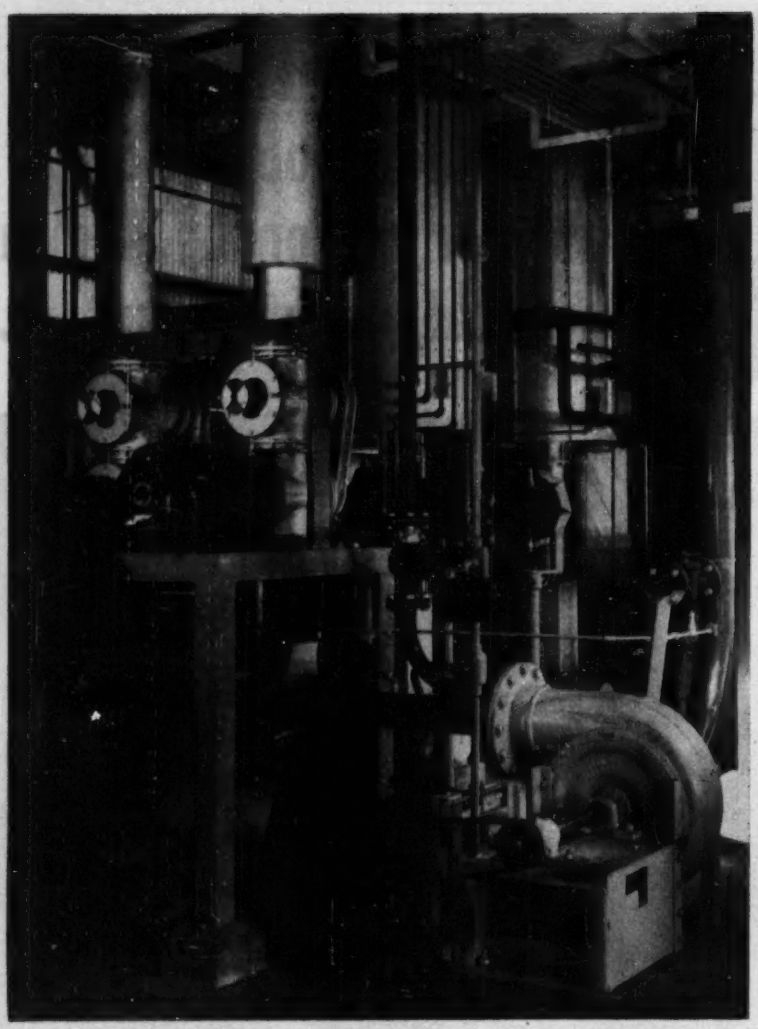

DOW CORNING's brand new fine-particle silica plant, evidence of a new . . .

Surge for Silicas

That buzz of activity in the ultra-fine silica field has already resulted in one new plant and several new products. More may be in the offing.

Fine-particle-size silicas are being made and used in ever increasing tonnages. Almost chemically pure SiO_2, these white powders, made in several different ways, are all characterized by their extremely small average particle size—4 to 25 millimicrons (1.6 to 10 x 10^{-7} in.). In addition to rubber reinforcing and grease thickening—prime fields—they are also used as emulsion stabilizers, flatting and dulling agents, thermal insulators and in a host of other applications.

Indicative of this interest in fine silicas is the high level of activity of several chemical companies:

• Early this year Godfrey L. Cabot, Inc., one of the top carbon black producers, began importing a fine silica, called Aerosil, from the German firm, Degussa.

• Late this year Dow Corning will put on stream, at Midland, Mich., a 30-tons-per-month plant using the Degussa process. The product will be used as a reinforcing agent in Dow Corning's heat-resistant silicone rubber, Silastic.

• Sometime next year Du Pont expects to initiate commercial production of two new fine silica products.

• Currently working on the commercial development of their silicone-modified silica aerogel is General Electric's Chemical Division. Prime target—grease thickener applications.

• Now producing at or near capacity are the other major producers: Columbia-Southern (Hi-Sil) and Monsanto (Santocel).

▶ **Cabot**—Since last March Cabot has been importing Degussa's* Aerosil for use as a reinforcer for various types of rubber and in a spate of other filler and thickener uses.

The product is pure (almost 99 percent) silicon dioxide of an extremely small particle size (4 to 20 millimicrons). The individual particles are believed to be roughly spherical and tend to agglomerate somewhat into branched chains. Because of the fine particle size, surface area per pound is enormous. It is this high surface area, coupled with high surface reactivity, which gives the product its excellent reinforcing properties.

Cabot will continue to import for the present, but as soon as it feels the demand warrants Cabot will build its own production facilities in the U. S. Their contention is that Aerosil is not meant to compete with the other, less costly, silica products—that each has its own sphere of uses, Naturally, they are betting that Aerosil will wind up in a greater number and wider variety of applications than the rest.

▶ **Dow Corning**—While developing its heat-resistant Silastic rubber, Dow Corning discovered that the limited heat stability of carbon black precluded its use as a reinforcing filler. An investigation of possible inorganic reinforcers turned up Aerosil as the most promising. D-C obtained a license from Degussa to use the process and also bought a plant from them to produce the product.

The Degussa process was developed on a commercial scale during the last war when a carbon black shortage threatened Germany. The original process bore a marked similarity to

* Deutsche-Gold- und Silber-Scheideanstalt Vormals Roessler of Frankfurt, Germany.

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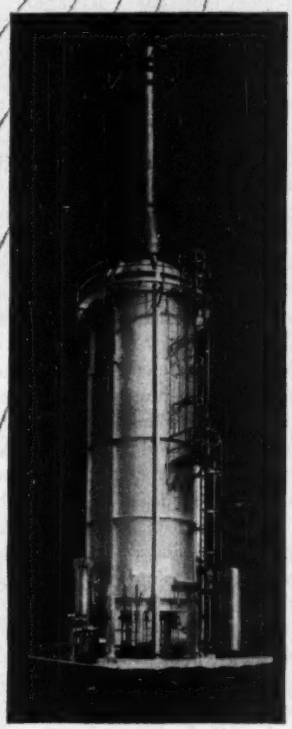

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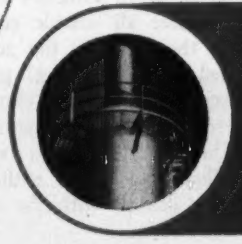

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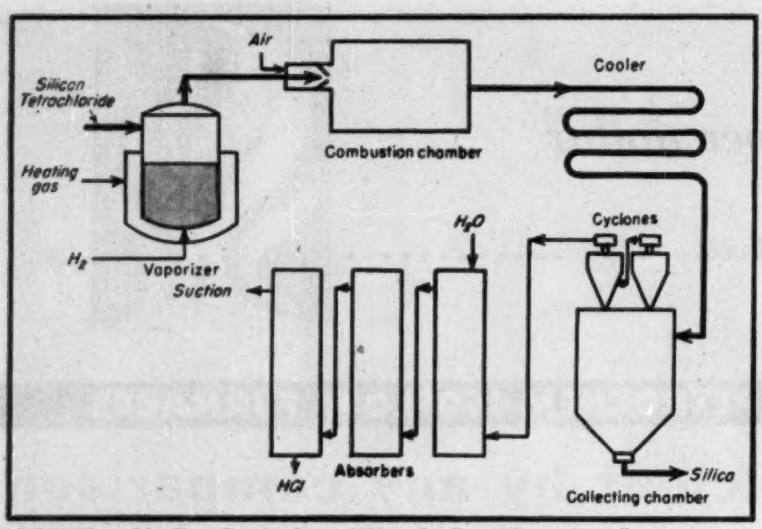

PROCESS used by Dow Corning burns SiCl, and collects silica as "soot."

PRODUCT is ultra fine SiO_2 (20,000x).

the channel process for carbon black. Silicon tetrachloride was volatilized with coke-oven gas and air. It was then burned and the resultant gases condensed on a water-cooled cylinder to deposit SiO_2. The chlorine left as anhydrous HCl.

American technical teams investigating German industry after the war unearthed the process and brought this knowledge back to the U. S. Enthusiasm for the process was tempered, however, by the realization that costs were high and the process could never compete with carbon black sources in a mass market.

Since the war Degussa has come up with a new and much more efficient process. This process closely resembles the furnace process for carbon black.

The improved process is simple and continuous, but design of equipment is critical and neither Dow Corning nor Degussa will say much on this point.

In the new method, silicon tetrachloride (or other volatile silicon compounds) feeds into a gas-heated vaporization chamber. Low-pressure hydrogen sweeps the vaporized feed out of the chamber in a controlled ratio and intimately mixes with it before reaching the burner. The mixture enters the burner along with air supplied for combustion.

Flames sweeping into the burner reach temperatures of 1,000 to 1,200 deg. C. Here the fine particles of silica form. "Soot" particles and by-product gases are then cooled and passed to the collecting chamber. Silica particles are knocked out, blown with heated air to remove the last vestiges of gaseous HCl and discharged to bags or drums. Byproduct gases (HCl and water) are stripped of the last traces of silica by two cyclones in series and sent to a standard three-stage HCl absorber. Recovered HCl is used in Dow Corning's methyl chloride plant.

D-C estimates that the future possibilities of Silastic are such that the entire output of its "silica soot" plant will go into heat-resistant rubber production indefinitely.

▶ **Du Pont**—Already a major producer of fine silicas, the Du Pont company next year expects to initiate commercial production of two new silica products, designated right now PL-171 fine silica and, simply, Du Pont fine silica. Now in pilot-plant production, the new products will be offered in a granulated form to facilitate shipping and handling.

Both are completely amorphous silicas (approximately 90 percent pure) with pronounced hydrophobic and organophilic characteristics. The granules are composed of spherical particles of 8 to 10 millimicron size bonded together into highly porous, sponge-like networks. Each granule has a high specific surface.

PL-171 fine silica has shown considerable promise as a thickener for multi-purpose petroleum-based greases. The other Du Font entry is being developed as a rubber filler, with its organophilic property and high specific surface responsible for good reinforcing action. Other uses are in the product development stage, but so far it looks good as a filler for silicone elastomers, as a thickener and filler for various plastics and resins and in a number of minor applications.

Du Pont won't say much regarding the production process except to indicate that both products are produced from sodium silicate via an aqueous process in which the minute particles of fine silica are formed. Granulation is accomplished without resorting to binders.

▶ **General Electric**—Another product currently in the commercial development stage is a hydrophobic silica aerogel. At GE's Chemical Division, Pittsfield, Mass., researchers are working on a method of modifying silica aerogel with a byproduct of the company's silicone production to make it water-repellent.

In the manufacturing process for the new product, a mixture of sodium silicate and the silicone component is neutralized with sulfuric acid. At the same time, alcohol is added to prevent gelation. Sodium sulfate is removed as a byproduct and a clear alcohol solution, an "alcosol," remains. This is sealed in an autoclave and heated to vaporize all volatile components. After these escape, the autoclave is cooled and the aerogel product removed in white, bulky chunks which are screened to reduce particle size.

The final product is both water-repellent and bulky, with bulkiness varying directly with the amount of silicone added.

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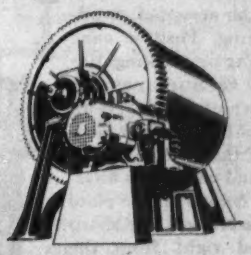

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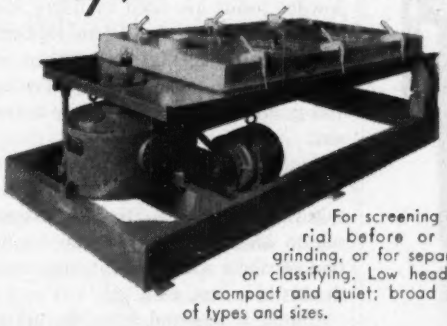

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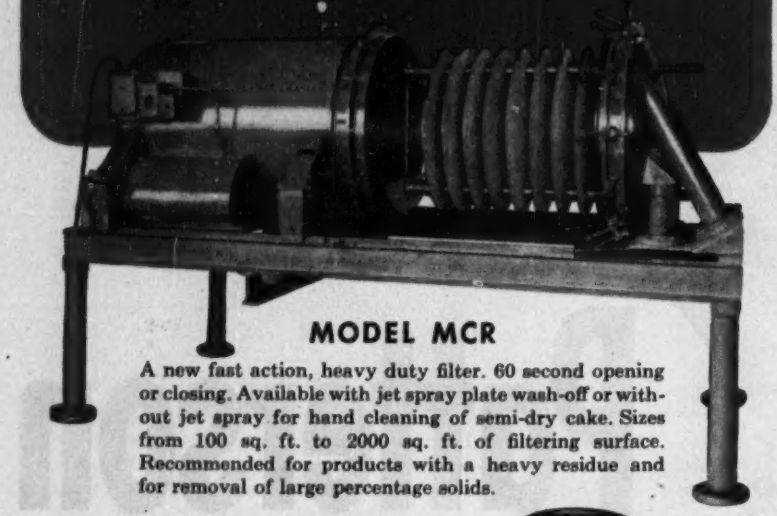

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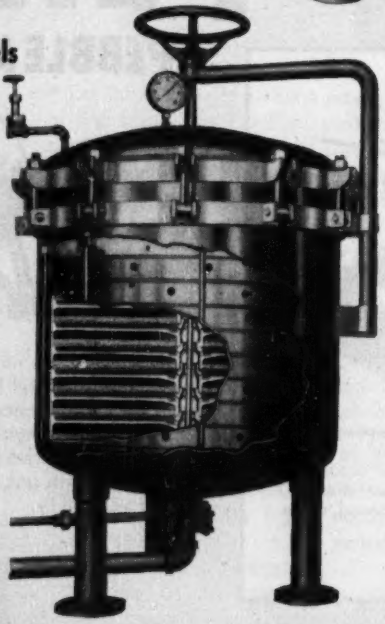

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WHAT'S HAPPENING, cont. . .

While the grease thickener field is expected to be the biggest outlet for this filler, GE is also exploring the silicone rubber market and the market for varnish thickeners.

▶ **Columbia-Southern**—Probably the lion's share of the present market goes to Columbia-Southern Chemical Corp., a subsidiary of Pittsburgh Plate Glass Co. Columbia-Southern, who had been making Silene, a hydrated calcium silicate, since 1939, introduced Hi-Sil, a hydrated silica, only four years ago.

Since its early days, Silene has been the standard reinforcing agent for soling materials. It is used extensively in leather substitutes, as well as in rubber compounding and myriad other uses.

Hi-Sil and Hi-Sil "C," a companion product of finer particle size, are used extensively in the production of non-black and synthetic rubber compounds. They are also used with powdered materials as moisture adsorbents, as finishing agents for paper and textiles, thermal insulators, stabilizers for paint pigments, grinding aids and as liquid thickeners.

Hi-Sil is made from a sodium silicate solution which is treated to precipitate the product, hydrated silica. The final product is a bulky, white powder with a particle size of about 25 millimicrons.

▶ **Monsanto**—Another major producer of finely divided silica is Monsanto. Its Santocel is a silica aerogel of very high porosity. One type, Santocel A, is currently marketed in the form of pea-sized lumps, while all other forms are ground to a very fine powder. The powder forms are used as fillers and reinforcing agents for silicone rubbers, as thickening agents, as flatteners in lacquers and varnishes, as flowing and grinding aids, and in many minor uses.

Santocel is made by treating a solution of sodium silicate with dilute sulfuric acid and separating the sodium sulfate which forms. The dilute solution of silicic acid thus obtained readily sets to a firm, clear gel.

Liquid is removed from the gel in such a way that shrinkage is prevented. This is accomplished by heating the gel in a closed container to above the critical temperature and pressure of the liquid. Liquid is converted to a vapor which is bled off, leaving the dry aerogel. This process is somewhat similar to GE's.

Chemico to Build New Titanium Dioxide Plant

A $14 million plant for the production of titanium dioxide will be built by Chemical Construction Corp. at Savannah, Ga., for American Cyanamid Co. Construction will be completed early in 1955.

First organized in 1914 at Charlotte, N. C., Chemical Construction Corp., an American Cyanamid subsidiary, builds chemical plants all over the world. It holds exclusive patents on many chemical plant designs and processes. Its contact sulfuric acid process has been installed in most of the industrial countries of the world, as well as in many government-owned and commercial plants in the United States.

The Savannah, Ga., titanium dioxide plant is the fourth major construction project currently being carried out in the South by Chemico. Others are the Texas City plant of Texas City Chemicals Co., the Nicholas, Fla., plant of Virginia-Carolina Chemical Co. and American Cyanamid's Fortier, La., operation.

American Cyanamid's Calco Chemical Division will operate the Savannah plant. It will be Calco's third plant for production of titanium dioxide, the others being at Piney River, Va., and Gloucester City, N. J. The Savannah plant will be designed so that its output can be doubled. The plant will consume about 100,000 tons of raw material a year. Titanium ore will come from Canada and India, and sulfur from the Gulf Coast.

Carbide Trims Price of Its Polyethylene Glycols

Carbide & Carbon Chemicals Co. has cut the price for nine different grades of its Carbowax polyethylene glycols. Four are liquids and five solids.

Polyethylene glycols are completely water-soluble and non-volatile. In the rubber industry they are used as release agents in molding foam rubber and as tire-bag lubricants. The pharmaceutical and cosmetic industries use them as bases for ointments, antiseptic dressings, lotions and creams; the textile industry as softeners and lubricants for fibers; and the metal industry as water-soluble binding agents for abrasives and as lubricants for extruded or drawn metal.

The water solubility and non-

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volatility of the polyethylene glycols are used to advantage in synthetic detergent bars, metal polishes, shoe polishes and printing inks. The liquid Carbowax polyethylene glycols are also employed as softeners and humectants and to make plasticizers and emulsifiers.

New Asphalt Refinery To Be Built in Ohio

A $4 million asphalt refinery will be built near Cincinnati, Ohio, by American Bitumuls & Asphalt Co. of San Francisco, one of the nation's largest asphalt manufacturing and marketing companies.

The plant will include a two-stage distillation unit, an administration building and laboratory facilities. Among other features it will have storage capacity of about 1.1 million barrels, including four tanks of 168,000 bbl. each, the largest of their kind in Ohio.

Especially designed for the refining of asphalt products, the refinery will manufacture all grades of asphaltic products.

Shipping installations will include facilities for loading and shipping by barge, tank car and tank truck. The truck operation will have special high-rate loading facilities to permit delivery of asphalt in the area to be served by the plant at application temper-

LITTLE BONER

On First Flush. . . .

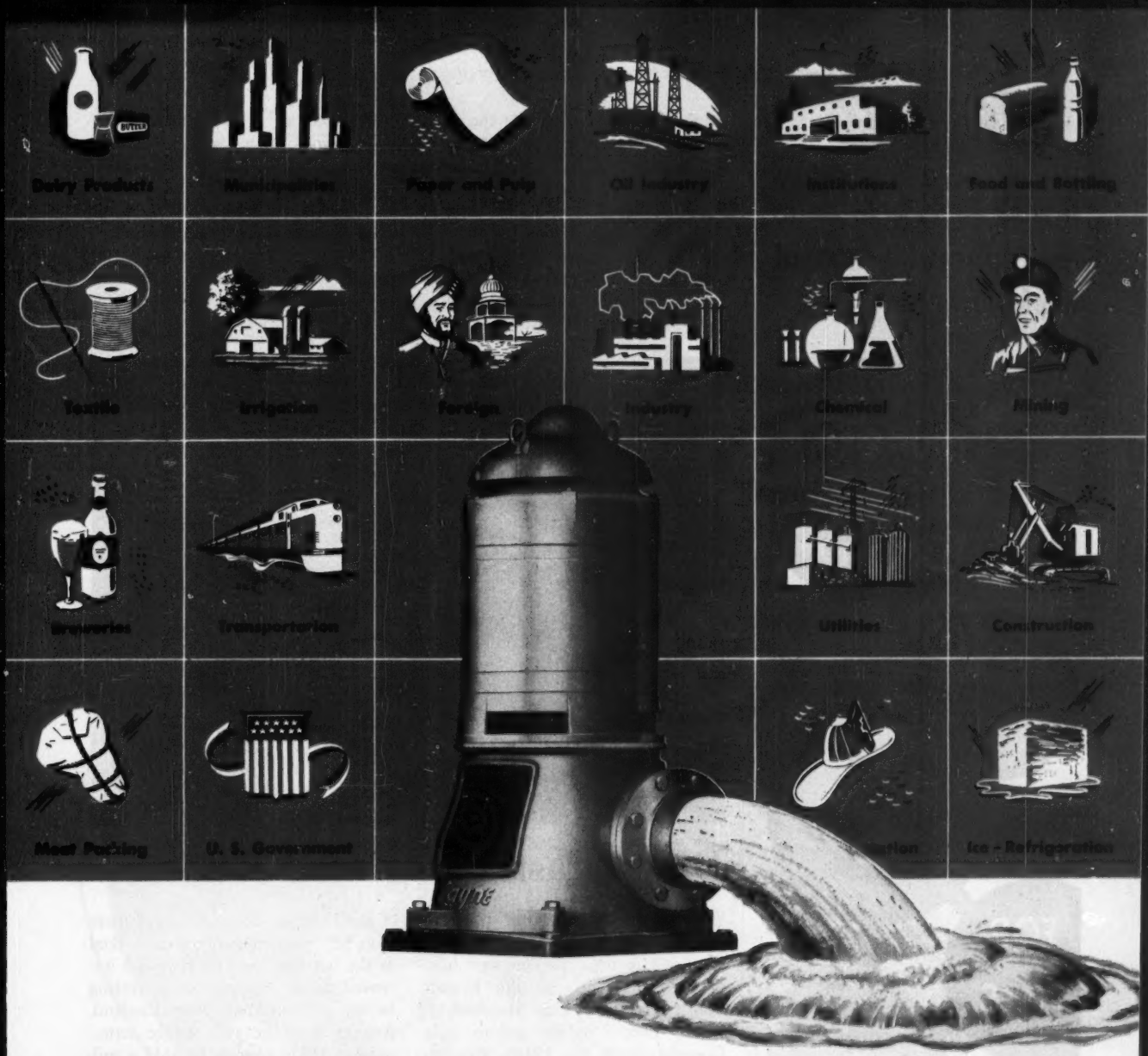
A Midwest chemical unit had put in a special evaporator for concentrating its liquid waste material, which was particularly "mean." For several weeks of cold runs the waste feed had been steadily accumulating.

Finally, on a Friday, the new unit was started up, operated for a few hours, then shut down ". . . all ready and OK to go on stream next week." Then with a well-won sigh of relief, the operators left for a long and care-free Labor Day weekend.

Tuesday morning the unit was "ready" all right—completely filled with dilute (very dilute) waste from the first effect right through to the effluent tank!

The boner? On the stuffing box of the first-effect circulating pump was a small water flushing valve. The operators had completely forgotten to close it when they shut the evaporator down.

"Yes, and there was a bit of hell to pay, too" wrote one of the operators. If you've ever come across a little boner as good—or better—than the one above, why not send it to the Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.



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Inglewood, Calif. Oakland 1, Calif.
Portland 7, Ore. Washington 6, D. C. San Juan 23, P. R.

atures. This will eliminate the need for heating on the site of the job.

The plant will be built on a newly acquired 100-acre site on the Ohio River at Miami Ford, 12 mi. west of Cincinnati.

The area to be served will include Ohio, Indiana, Kentucky and Michigan. The plant will supply and supplement the company's existing manufacturing facilities at Columbus, Ohio, and Howell, Mich., where Bitumuls emulsified asphalt plants are maintained, and at Louisville, Ky., for various grades of paving asphalts, emulsified asphalts and cutback asphalts.

The refinery will employ about 100 when it is completed. Construction will require a force of close to 600 workers.

Down East: Integrated Refinery

First catalytic cracking plant in New England, a 24,000-bbl. fluid unit, will increase gasoline and heating oil production at the Everett, Mass., refinery of Esso Standard Oil Co. to over a million gallons daily. Completion of the 191-ft. structure climaxes a multi-million dollar modernization and expansion that gives New England its first complete oil refinery.

Total production of the plant has been raised to 2 million gallons a day. Its major products: gasoline, kerosene, heating oil, fuel oils and asphalt.

In addition to the cracking unit, other new facilities include a 7,000 bbl. per day re-run pipestill and new and improved light ends facilities. Crude oil throughput has been raised from 38,000 to 50,000 bbl. per day. Higher yields of gasoline and heating oil will be recovered from the increased crude capacity and the conversion of what were heretofore heavy byproducts.

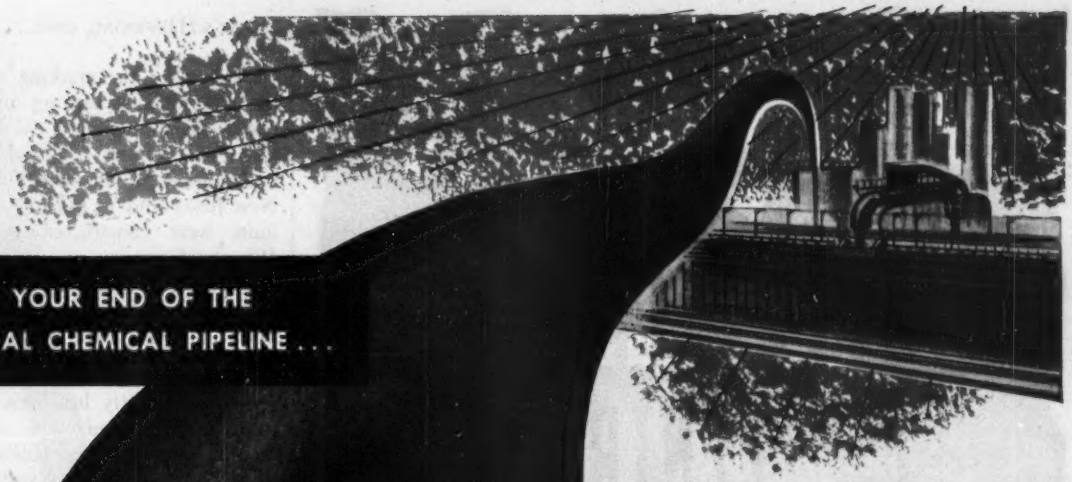
The outlay for the modernization of the Everett refinery is part of more than $23 million Esso has earmarked in the last five years for new and improved manufacturing and marketing facilities throughout New England. Among these are two storage terminals, each big enough to hold a million barrels, that are nearing completion in New Haven, Conn., and Waltham, Mass.

Because of existing facilities and equipment at Everett, only 4,000 tons of steel were required for the project, compared with about 30,000 tons needed for equivalent new refinery capacity.

Development of the Everett refinery will make it self-sufficient in the production of high-quality gasoline. Heretofore, components were shipped from other plants for the manufacture of premium fuel.

Originally constructed in 1919, the Everett refinery occupies about 125 acres on the outskirts of Boston and employs about 550.

Process design and equipment spe-



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cifications for the cracking unit and the revamping of existing units were completed by Standard Oil Development Co., central technical research organization for Standard Oil Co. of New Jersey and its affiliates. Process units were constructed by Foster Wheeler Corp.

Dow Teams With Japanese In Saran Production

A new industry has been born in Japan, the manufacture of saran monomer and polymer plastics. A new plant at Nobeoka on Kyishu Island has just started saran manufacturing operations. It is jointly owned by Dow Chemical International Ltd. and Asahi Chemical Industry Co. Ltd., thus reflecting the new era of economic cooperation between Japanese industrialists and the United States.

Earlier this year, the two companies, operating in Japan as Asahi-Dow Ltd., opened a saran extrusion plant at Suzuka City on Honshu Island. Until now, however, extrusion operations depended on imported materials.

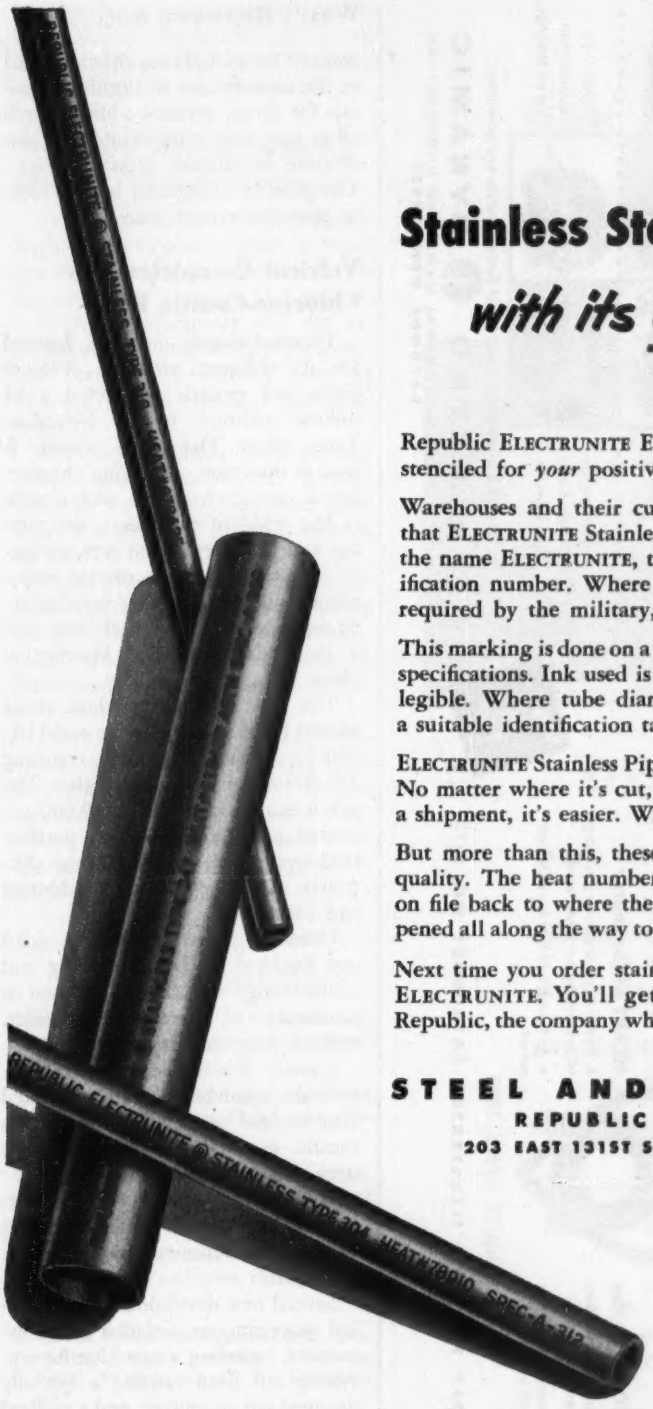
The Nobeoka plant, using local raw materials, will ship its output directly to the plant on Honshu Island, where it will be made into monofilaments for use by Japanese industries for the manufacture of plastic products. Chief among them will be nets for Japan's vast fishing industry.

Max Key, vice president of Asahi-Dow and manager of saran production of the Dow Chemical Co. went to Japan to supervise the initial manufacturing operations and to participate in a board of directors meeting of Asahi-Dow.

Victor Expands Production Of Phosphorus Chlorides

Phosphorus oxychloride and phosphorus trichloride will be produced in a new plant that Victor Chemical Works is building at Morrisville, Pa. The new plant will more than double Victor's present capacity for these phosphorus chemicals, which it currently produces at its Chicago Heights, Ill., plant.

"Present plans," says President Rothe Weigel of Victor, "call for completion of the new plant some time in the early part of 1954. The growing



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But more than this, these stencils are marks of Republic ENDURO quality. The heat number means Republic has all the information on file back to where the ingots began. Republic knows what happened all along the way to make each piece as good as stainless can be.

Next time you order stainless steel pipe and tubing, make sure it's ELECTRUNITE. You'll get the top quality in stainless steel from Republic, the company which pioneered this metal of over 10,000 uses.

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demand for phosphorus chlorides used in the manufacture of organic chemicals for drugs, gasoline additives, and other new uses is responsible for this decision to increase these facilities." The plant is strategically located close to potential market areas.

Velsicol Completes New Chlorine-Caustic Plant

To meet sharply increased demand for its chlorine products, Velsicol Corp. has recently completed a $2 million addition to its Memphis, Tenn., plant. The added capacity is now in operation, producing chlorine, liquid caustic, hydrogen and bleach.

The addition includes a salt storage and brine separation area, a caustic preparation area, a caustic evaporation building, a rectifier installation, an expanded electrolytic cell room and a modernized chlorine liquefaction plant.

The new unit will produce about 88,000 lb. of liquid chlorine and 110,000 lb. of caustic per day, requiring 180,000 lb. of raw salt materials. The salt is moved from three 100,000-gal. storage tanks through brine purification equipment, and then into electrolytic cells for conversion to chlorine and caustic.

Chlorine gas is then cooled, dried and liquefied by further cooling and compressing. The chlorine is used in production of chemical insecticides, textiles, pulp and paper.

Caustic leaves the cells together with the spent brine and is converted into its final marketable form in the caustic evaporation building. It is used mainly in soap products.

Hydrogen, a byproduct of the process, is piped directly to manufacturers of cooking shortening products near the plant.

Several new developments in chemical processing are included in the expansion, including a new filter for separating salt from caustic, a specially designed salt crystallizer, and a method for cooling hot chlorine vapor by direct contact with chilled water.

The consulting engineering organization of R. B. MacMullin Associates of Niagara Falls did much of the fundamental engineering work leading to the improvements in the Memphis plant. The H. K. Ferguson Co. of Cleveland, Ohio, constructed the plant and installed the equipment.

Velsicol Corp. is a division of the Arvey Corp. founded in Chicago in 1905. Velsicol currently employs about 2,500 in its various plants.

Minnesota Mining Steps Up Roofing Granule Capacity

Minnesota Mining & Manufacturing Co. will expand its plant at Wausau, Wis., for the manufacture of roofing granules at a cost of $1.5 million.

Crushing equipment will be installed at the quarry north of Wausau, and the granule coloring plant in Wausau will be expanded and modernized.

The new facilities will increase granule production of the Wausau plant by one-third. The plant is already the largest of its kind operated by 3M.

Other quarries and roofing granule plants operated by Minnesota Mining are at Little Rock, Ark., and Corona, Calif. The company also plans to build another granule plant in Somerset County, New Jersey.

Work on the new facilities at Wausau is under way, with completion expected about June 1, 1954. 3M has produced colored granules since 1932. About 90 percent of the homes in the United States have granule-coated asphalt roofs.

CONVENTION CALENDAR

Manufacturing Chemists' Association, mid-year meeting, Waldorf-Astoria Hotel, New York, November 24.

24th Exposition of Chemical Industries, Commercial Museum, Philadelphia, November 30-December 5.

Chemical Engineering Achievement Award, presentation banquet, Bellevue-Stratford Hotel, Philadelphia, December 2.

Mid-Century Conference on Resources for the Future, Washington, D. C., December 2-4.

Chemical Specialties Manufacturers Association, annual meeting, Mayflower Hotel, Washington, D. C., December 6-8.

American Chemical Society, regional conclave, Jung Hotel, New Orleans, December 10-12.

American Institute of Chemical Engineers, annual meeting, Jefferson Hotel, St. Louis, December 13-16.

Commercial Chemical Development Association, winter meeting, Statler Hotel, St. Louis, January 19.

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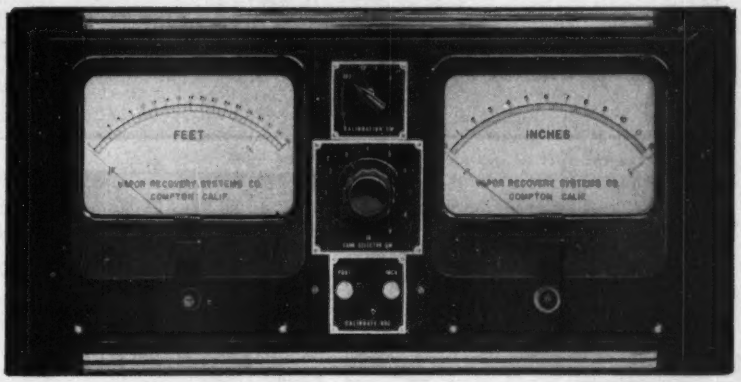

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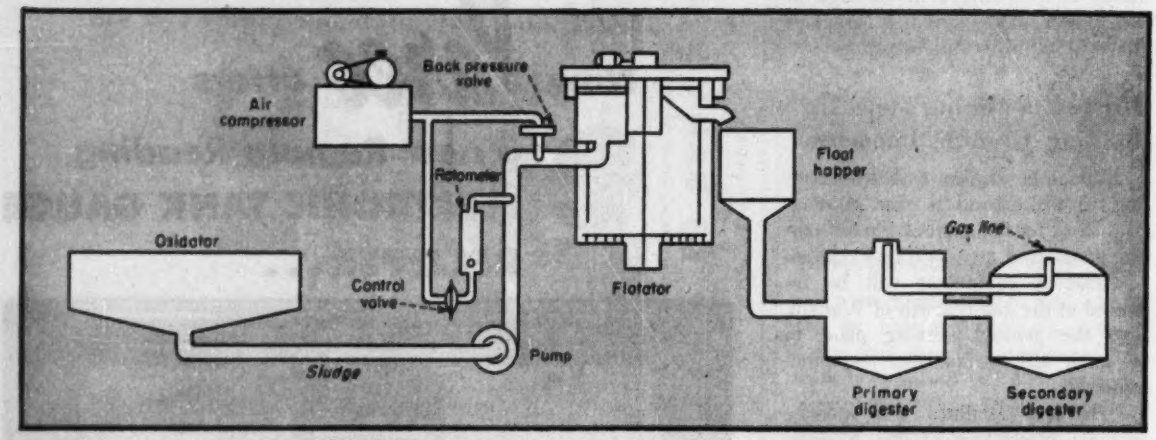

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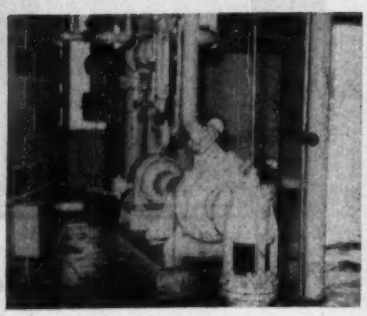
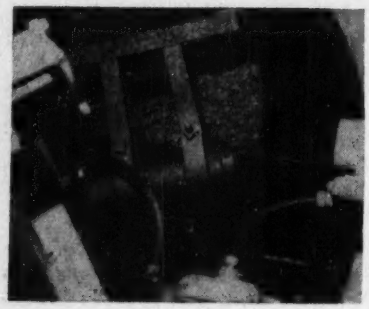


AIR PUMP



FLOAT HOPPER

New Bugs Chew Warm Waste

PROBLEM: To eliminate brewery and municipal pollution.
SOLUTION: A novel process using entirely new bacteria.
RESULT: Job done with smaller equipment and lower cost.

Less than six months ago, Clear Creek in Colorado wasn't living up to its name. Untreated municipal wastes from the city of Golden (pop. 6,500) were being discharged into the stream. On top of that, wastes from Adolph Coors Co.'s huge brewery at Golden—largest in the Mountain West and serving the Denver area—were also dumped directly into the stream without treatment.

When the Colo. Department of Health frowned on these practices, the brewery and the city got together to work out a joint solution to the problem. The answer was a new treatment plant, which started operating in August. Designed for a capacity of 3 million gal. per day, the new plant incorporates unusual features:

- Bacterial digestion is carried out at a temperature of 130 deg. F. in the primary digester, as contrasted with 80 to 98 deg. F. in conventional digestion. This yields 75 percent reduction of volatile solids in 17 to 20 days instead of the usual 55 percent in 30 to 60 days.
- A pressure flotation unit concentrates the sludge to 10 percent solids, as compared with 1.5 to 3 percent solids content in the customary aeration of raw sewage. The plant is the first in the U. S. with this type of unit for the concentration of sludge prior to digestion.
- Use of high-temperature digestion and the flotator requires a primary digester tank only one-third as large as in a conventional plant. This reduces construction costs—exactly how much Coors officials cannot state for the record. The work was done entirely by Coors' own construction department, which has its own concrete mix plant, concrete mixer trucks and other equipment. A figure of $231,000 for the plant cost is being widely circulated among municipal officials, with the understanding that a similar plant would cost about $500,000 for most municipalities.

▶ **Pilot Plant**—Experiments with a pilot plant for more than a year led to the new ideas incorporated in the full-scale plant.

The search for suitable bacteria was one of the most difficult problems. Of course, the experience of Coors' laboratories with brewing cultures was a head start.

Many of the bacteria studied in the course of this work survived the high temperature but failed to produce methane, a desirable byproduct of waste disposal operations. Finally, two kinds of thermophilic bacteria were isolated to do the job. They are gram-negative rod types that multiply every 20 minutes. Both aerobic and anaerobic organisms are present in the culture.

ENGINEERED DUST CONTROL... KEY TO EFFICIENCY AND HEALTH

Asbestosis—a deadly lung disease caused by inhaling dusts created by asbestos mining and manufacturing processes—has been a long-time menace to the health and efficiency of workers in the asbestos industry.

Following an exhaustive search for efficient methods of eliminating these insidious particles, one of the world's largest producers of asbestos had Dracco-engineered Dust Control Systems installed in their three plants.

Now 50 to 100 pounds of these lethal asbestos dusts are withdrawn every minute from the plant atmosphere by integrated Dracco Filters providing constant and uniform peak-efficiency dust control.

By relying on Dracco to overcome the asbestosis hazard to employees, the firm has protected their health and reduced absenteeism. Greater productivity resulting from improved manpower efficiency has contributed to increased profits.

Whether your problem is controlling *harmful* dusts or collecting *valuable* dusts, call Dracco for the "profit-engineered" solution which meets your process requirements.

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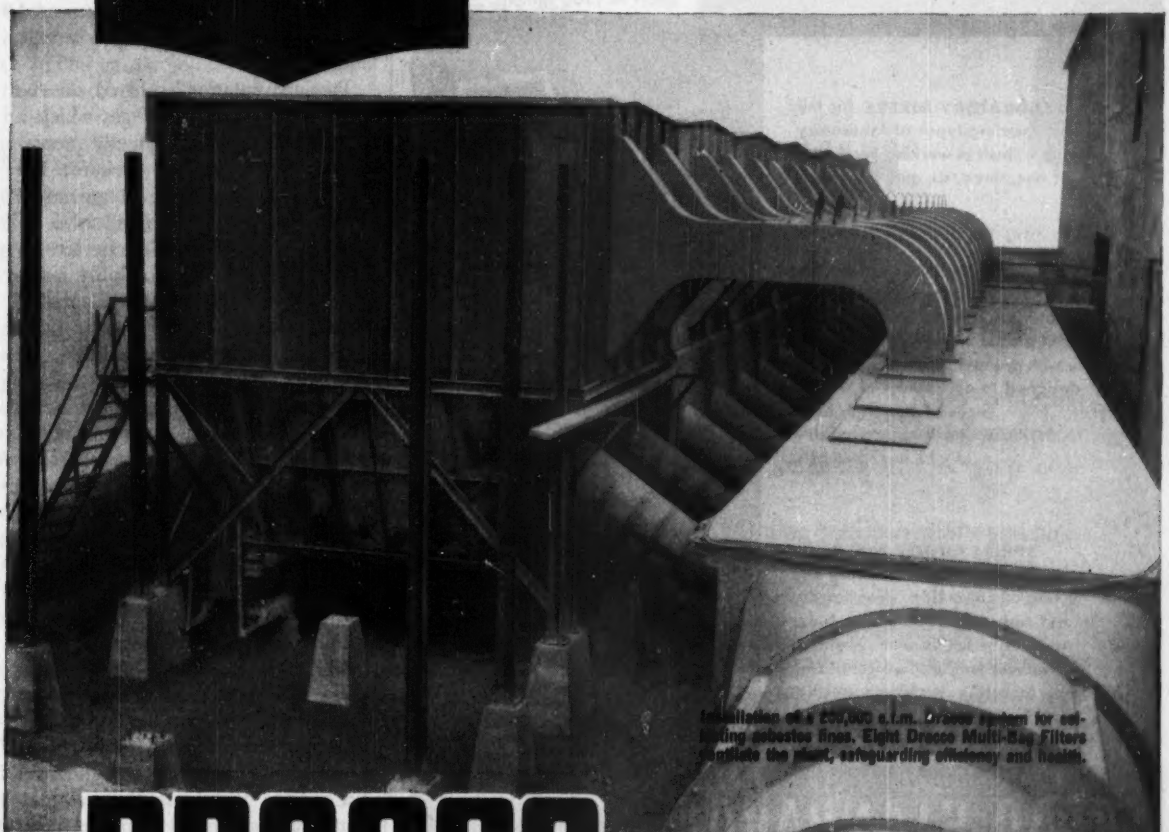

Installation of a 200,000 c.f.m. Dracco system for collecting asbestos fines. Eight Dracco Multi-Bag Filters ventilate the plant, safeguarding efficiency and health.

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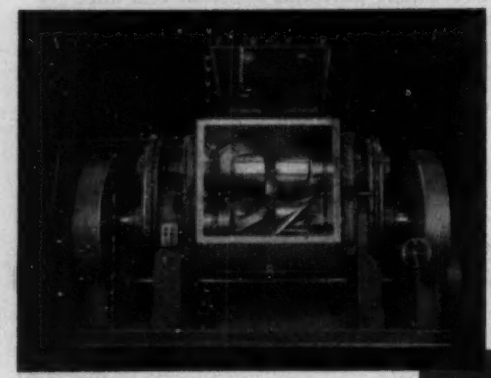

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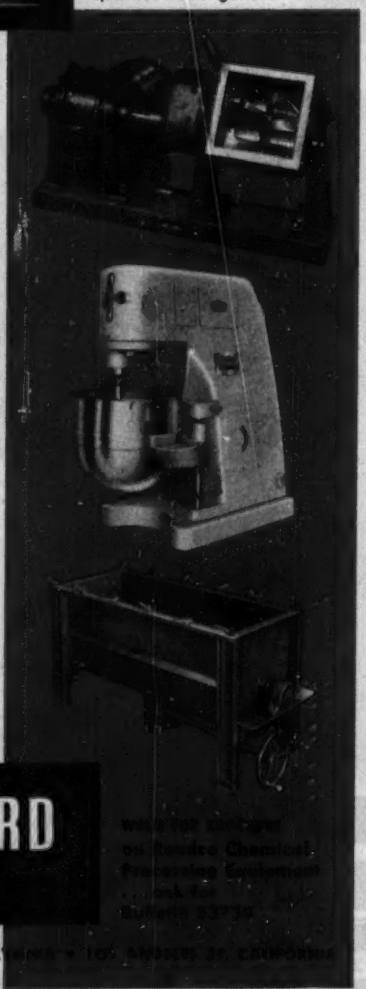

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The volume of methane produced by these bacteria is no greater than that produced by the mesophilic variety at the lower temperatures. However, they do their work a lot faster.

Bacteria of the mesophilic range can't digest oils and fats. These materials coat organic matter, which then rises to form a sludge blanket at the surface of the digester. The new thermophilic bacteria, cultivated at 130 deg. F., penetrate the oils and attack the organic matter, preventing formation of the sludge mat.

► **Pressure Flotation**—Paper mills originally developed pressure flotation to handle difficult disposal and recovery problems; this technique is used also in oil refineries, soap plants, packing houses, and in the disposal of railroad shop wastes (see *Chem. Eng.*, June 1952, p. 270). Process Engineers (Los Angeles) supervised the installation of the flotator. The firm reports that this is the first time the unit has been used for the concentration of sewage sludge.

Pressure flotation is based on the fact that the amount of gas which a liquid will dissolve is directly proportional to the absolute pressure. For example, at 1 atm. and a temperature of 70 deg. F., water will dissolve approximately 2 percent of air by volume. At 2 atm. the solubility is approximately 4 percent, at 3 atm., 6 percent, etc.

When the pressure is reduced, the volume of air or gas present above saturation at the lower pressure comes out of solution in the form of extremely fine bubbles. These bubbles attach to the suspended matter present in waste waters and carry the solids to the surface. Then the solids can be removed by skimming the surface.

► **Operation**—The combined brewery and municipal waste is pumped through a 2-ft. dia. clay tile sewer 1,988 ft. long. The flow then goes through a bar screen to take out large debris and through grit chambers that take out sand and other solid particles. The sewage then passes through powerful grinders that crush the remaining matter and a Parshall flume for metering the flow.

The oxidator-clarifier, next in line, is 90 ft. in dia. and 12 ft. deep. Here the sewage is coagulated and settled out as sludge. Air is injected into the oxidator to cause violent agitation of the sewage.

In the conventional plant the sludge at the bottom of the oxidator usually has a 1.5 to 3 percent solids content. The pressure flotator, next in the process, increases the sludge content to 10 percent before it passes on to the primary digester. The flotation unit is adjustable to concentrate the sludge in any range from 6 to 10 percent, at the operator's discretion.

▶ **Digesters**—The concentrated sludge is scraped off and discharged into the primary digester. This is a concrete tank, 35 ft. in dia. by 30 ft. deep, with an outer shell of colored hollow tile to match the plant's control house.

Four inches of blown glass wool insulation was placed between the concrete and the tile for 15 ft. above ground level. Additional cork and asphalt insulation are used below grade. In addition a tile drain is installed to intercept ground water so that it doesn't carry away heat from the digester.

▶ **Cheap Fuel**—Methane is produced in the Coors-Golden plant at a rate of 15,000 cu. ft. per day. It is stored in the secondary digester and is used to operate the boiler that heats the primary digester by steam injection. The secondary tank has a 34,000-lb. floating steel top which maintains a 6-in. w. g. pressure on all lines to the gas-burning equipment in the control house.

The plant has been designed for a peak capacity of 3 million gal. of sewage per day, which is twice the present flow. This allows for both expansion of the brewery and growth of the city.

▶ **A Major Problem**—Many of our states have had statutes for 50 years or more prohibiting pollution of our streams by "waste matter", but it has not been until very recent years that the authorities have been granted police powers.

As the exercise of these powers becomes more strenuous, many small municipalities, and industrial plants as well, will be forced to focus their attention on the problem of stream pollution and the rather large costs which are involved in establishing treatment facilities.

Coors officials hope their treatment plant will point the way to cheaper waste disposal methods for small communities. They have made the plant available to Colorado colleges as a laboratory for experiments in sewage disposal and also for instruction.

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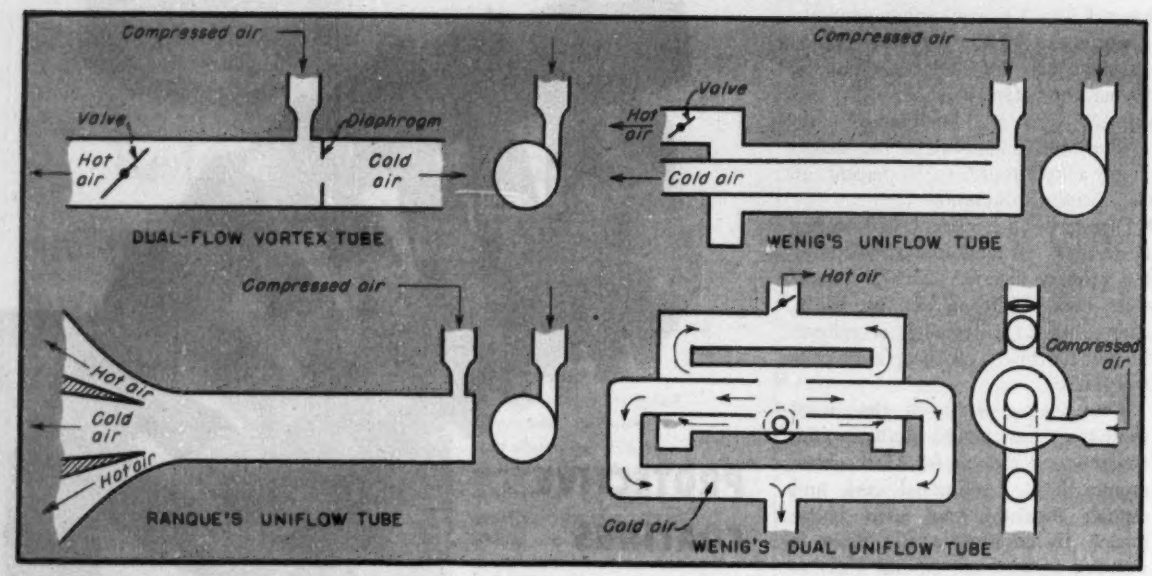

Solid Facts Undo Old Theories

Research work at NYU reveals what really goes on in a vortex tube. Improved designs and broader application of this temperature-separation device should result.

The Ranque-Hilsch vortex tube—that engimatic device which splits a flow of gas into two streams, one hot and the other cold—is beginning to yield some of its mysteries to inquisitive research engineers.

Recent work at New York University has upset previously held theories which assumed that the split of the gas into hot and cold streams was the result of heat and momentum transfer taking place as the gas flowed down the hot tube. Harold Wenig, working in the mechanical engineering department at NYU, found that the entering air stream actually separates into hot and cold streams immediately upon entering the nozzle section, or vortex.

This means that the conventional "dual-flow" vortex tube, as patented by Georges Ranque, a Frenchman, and further developed by Rudolph Hilsch in Germany during World War II, can be basically improved. Its only true function is to separate the hot and cold gas streams before they can mix. Wenig claims that a new "uniflow" design, based on his experimental findings, can be built smaller and can operate more effectively.

▶ **How It Began**—Technical ingestigators entering Germany right behind the military in the spring of 1945 found Hilsch applying the vortex tube in his low-temperature physics laboratory at the Physikalisches Institut in Erlangen. He was using it to precool his apparatus prior to the Joule-Thomson expansion, thus reducing the amount of liquid air which he had to buy.

Hilsch found this odd device to be a convenient laboratory tool—it involved no moving parts and required only a supply of compressed air. Since he needed only small amounts of cooling at infrequent intervals, he wasn't worried about its inefficiency.

Hilsch's subsequent technical paper aroused a lot of scientific and lay interest. Some of the efforts to explain what went on in a vortex tube went to absurd lengths, referring to Maxwellian demons and violation of the second law of thermodynamics.

Although Hilsch's work popularized the temperature-separating property of the vortex tube, it was Ranque who deserves credit for the original discovery, made in the early thirties. He disclosed his invention, for obtaining a hot and a cold stream of gas from a gas initially under pressure, to the U.S. Patent Office on Dec. 6, 1932, after having received a French Docket. He assigned the patent to La Giration Des Fluids (translation, Whirl-Gas) of Montlucon, France, a small company that he probably hoped would revolutionize the refrigeration industry. In time he accepted the fact that the device could not compete with conventional refrigeration equipment. The invention remained virtually unknown until Hilsch's use of the idea.

▶ **Design and Operation**—Basically, the vortex tube designed for temperature-separation effects consists of a tube whose length is some 30 to 50 times its diameter, with a nozzle arranged to direct expanded gases tangentially into the tube (see cut). A diaphragm with a hole one-fourth to one-half the tube diameter is placed close to the nozzle section. At the opposite end of the tube is a valve.

When compressed air expands through the nozzle into the tube, it creates a vortex flow. If the valve is wide open, air will be sucked into the hot tube through the diaphragm. As the valve is gradually closed, a point will be reached when air will begin to flow out of the hot tube through the diaphragm. The air flowing out through the diaphragm will be cold, while the air passing through the valve is warm. A temperature depression of 100 deg. F. is reasonable, depending on moisture content of the air.

▶ **Probing the Mysteries**—At the time Wenig began his doctorate research at

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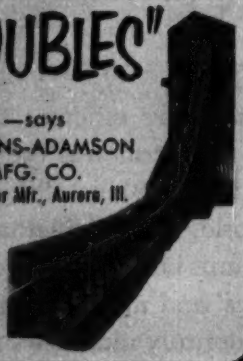

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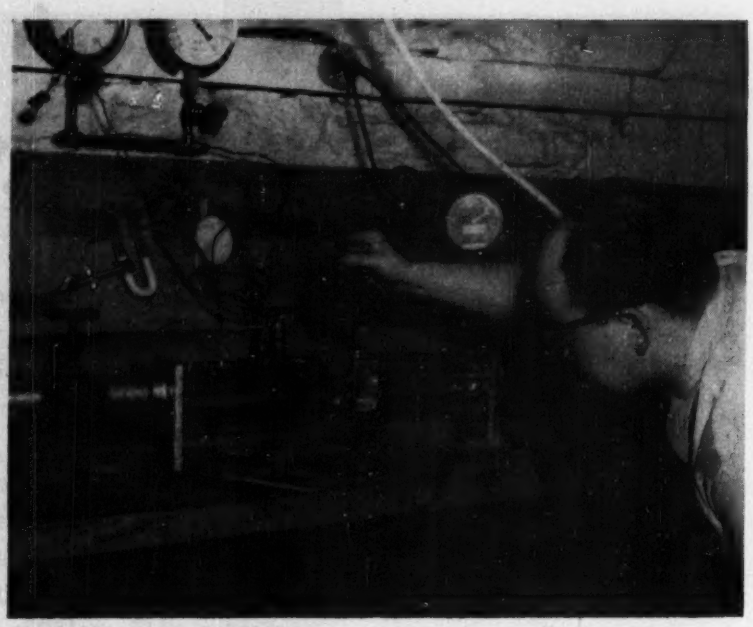

RESEARCH engineer Harold Wenig probes the mysteries of the vortex tube.

NYU, no adequate theory explaining the Ranque-Hilsch effect was available. Wenig's proposed program was to probe experimentally the vortex tube with temperature and pressure-measuring devices in order to establish the nature of the flow. From experimental data he hoped to construct a theory explaining the mechanism of energy transfer. This approach was suggested by Prof. M. L. Weidmann of Yale University.

In the initial planning stages, he decided to build the equipment so that the basic vortex—that produced in the tube with a blank diaphragm or with no diaphragm at all—could also be studied. He thought that this would yield useful information which might be related to the Ranque-Hilsch effect. This proved to be a fortuitous decision, as this approach focused attention on the fundamental nature of the phenomenon.

▶ **Test Apparatus**—The experimental vortex tube, made of Lucite, consisted of a center block, containing the nozzle and diaphragm, and two tubes for the hot and cold air. These were held together between steel supporting plates. The vortex tube was ¾ in. in diameter; two different nozzle blocks were used, one with a 0.0995-in. nozzle and the other with a 0.1495-in. nozzle. Temperature and pressure probes were made with 20-gage hypodermic needles.

Air was supplied at pressures up to 200 psi. by a 7½-hp., two-stage reciprocating compressor. The air was dried over silica gel beads. Air flow was measured by the Nash Engineering Co. orifice method, which uses an accurately calibrated orifice discharging freely to the atmosphere.

▶ **Localized Effect**—Wenig's measurements made with the temperature and pressure probes indicated that the Ranque-Hilsch effect was not a progressive phenomenon that increased along the hot tube; rather, it was confined to the nozzle section. In other words, the distribution of air into hot and cold air occurred right at the entrance to the tube. "We certainly didn't anticipate these results," admits Dr. Wenig, "and they changed the entire course of the investigation."

In his patents Ranque had suggested a uniflow type of vortex tube for temperature separation. Although other investigators discussed this design, none seems to have built one.

According to previous theories a uniflow tube would have to provide a path of appreciable length to allow establishment of a temperature gradient. Wenig's results indicated, however, that this design wouldn't work, because heat transfer would destroy the temperature gradient which had already been established in the nozzle section. He reasoned that a short uniflow vortex tube would function well

if the cold gas was separated from the rest of the air stream near the nozzle section. He built such a tube (see cut) and found that it worked very well.

▶ **Future Prospects**—Although Wenig is now with Bulova Research and Development Laboratories, Valley Stream, N. Y.,* he is still working on the vortex tube in his spare time. He recently built and tested a further refinement of the uniflow idea, a "dual uniflow" vortex tube. He believes that this design can operate at a high enough efficiency to make it attractive commercially for a number of small cooling jobs.

Industrial applications of the vortex tube right now seem to be limited to intermittent, small-scale laboratory uses. However, the military is said to be seriously interested in vortex tubes, although specific applications can't be revealed.

A new twist in use of the vortex tube is as a velocity meter for aircraft. The usual pitot tube air-speed indicator requires correction for air temperature. But measurement of the temperature of the air surrounding a moving airplane with the customary devices requires, in turn, correction for velocity. As a result, accurate air-speed measurement actually involves a series of approximations.

The vortex tube can be used to measure temperature of a moving air stream (or air outside a moving aircraft) by balancing the flows of hot and cold air in a certain way. More recently it has been shown that the vortex tube can be used for direct velocity measurement by proper calibration of the temperature difference between hot and cold streams in terms of air velocity.

*Assistant Professor William H. Roberts, Jr., who supervised the work at NYU, is now with Carrier Corp., Syracuse, N. Y.

Six-Stage Bleaching Part Of Paper Mill Expansion

St. Regis Paper Co. plans a $4.5 million expansion of its kraft mill at Pensacola, Fla., to be carried out by Tidewater Construction Co. of Norfolk, Va. The expansion is expected to be completed by July 1954.

New facilities will include a six-stage bleaching plant, increased water supply, a screen room extension and modernization of the No. 1 paper machine for production of bleached fourdrinier grades.

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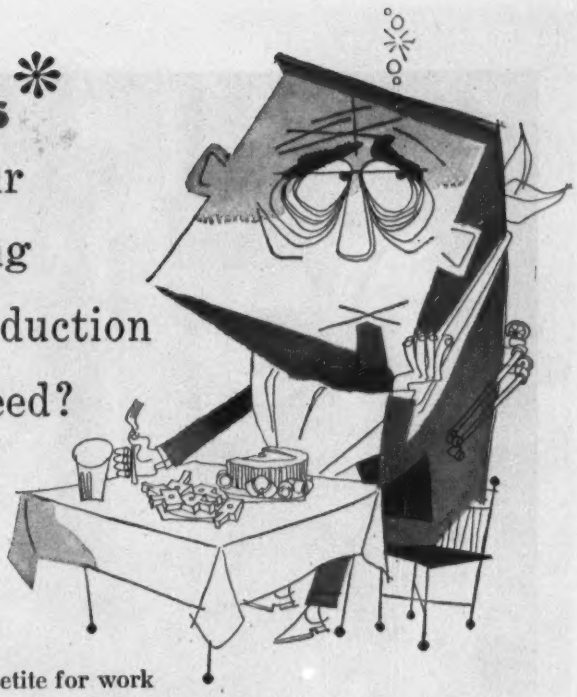
coil-itis * have your processing tank production off its feed?



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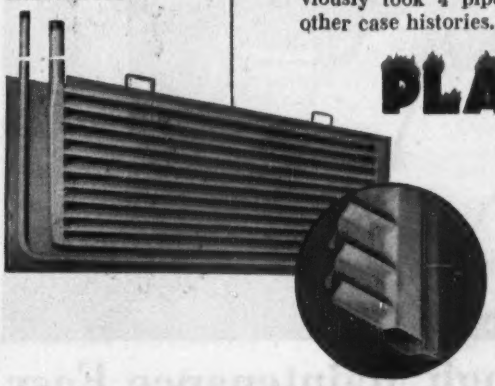

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After several years of exhaustive testing, a team of Du Pont Chambers Works medical, safety, operating and engineering personnel has come up with an anti-contamination suit designed for use where chemical toxicity hazards exist. It allows a worker to perform his duties in complete safety and comfort in contaminated atmospheres where, up to now, the men could work only for very brief periods of time because of the danger and discomfort to skin and other exposed parts.

▶ **One Piece Job**—The suit itself consists of a one-piece neck-to-toe coverall, complete with glove and boot extremities, somewhat like the Navy's immersion suit. It has a separate helmet and hood combination with front-and-back bibs that snap on to the suit proper and protect the neck opening.

Made of thin, tough impregnated fabric which is highly impervious to gaseous as well as liquid or solid toxic materials, the suit is light in weight and perfectly comfortable to the man wearing it. The secret is a well-designed system of ventilation. Air dehumidified and cooled or heated to the desire of the worker, is supplied to the suit through a flexible metal hose whose woven-metal armor also acts as a life line, being able to support 600 lb. dead weight. This is affixed to a body harness inside the suit.

A tee outlet sends part of the air supply into the suit proper and another part separately to the hood. The dehumidified air prevents fogging of the face visor as it accommodates respiration. Tubing, inside the suit, vents the air at each wrist, each ankle and at the midriff.

Air from the suit and hood is exhausted from under the bib of the hood. Being under slight pressure, according to the desire of the wearer, the constant flow of air (6-15 cu. ft. per min.) prevents fumes or dust from backing into the hood. The air flow and humidity are controlled by a rotameter and other instruments after air is taken from the taps of standard air-mask supply lines in plant buildings.

The suit solves, among other things, the problem of amino and nitro compounds which might be absorbed through respiration or through the skin. These have been especially troublesome.

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working where there might be an exposure to these, (such as repairing or cleaning the interior of a vessel wherein some toxic residue might have remained after flushing operations) were limited to only a few minutes of time within the vessel. They were also required to wear air masks and, frequently, heavy rubber suits, gloves and other cumbersome clothing.

Du Pont recently used two men wearing the suits for a tank repair job. The repair was completed in 3½ hr. of uninterrupted work. A similar job, with men limited to only 15 min. per day and a complete medical checkup for each after his trick, would have taken a crew of at least 20 men to alternate on the work. That way, the job might have taken two or more days.

The new suit, which offers little restriction to movement of the wearer, will allow the employee to work in contaminated atmospheres for six hours or more.

After many tests, Du Pont Butyl Fairprene was found to be an ideal fabric. A host of changes and modifications in style of the garments were also effected as the experimentation went on. Some of the ideas were suggested by the mechanics who helped test the suits.

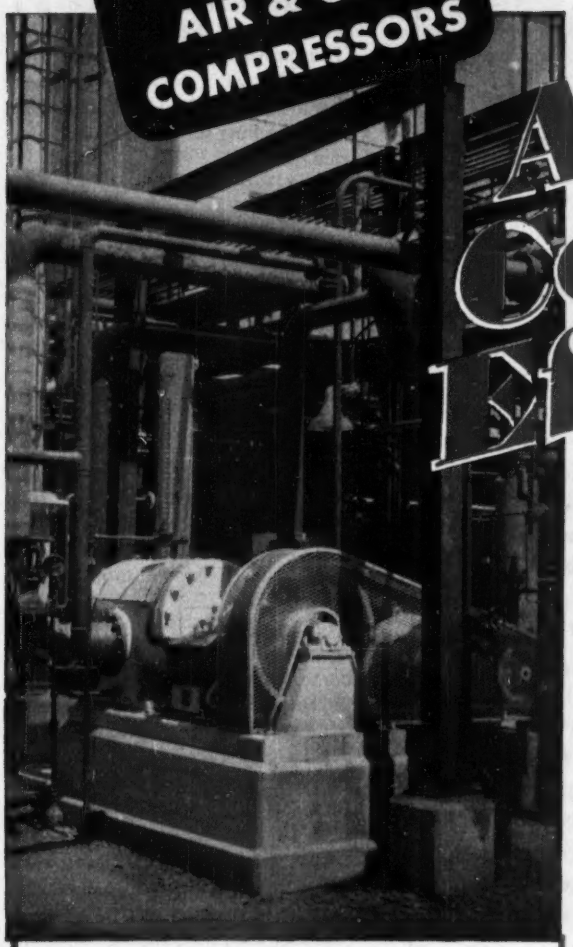
A Du Pont spokesman says that the company has no intention to restrict rights for manufacture, sale or use of the garment. So far, two Philadelphia firms have fabricated suits to the Du Pont specifications.

Meanwhile similarly styled suits, made of other materials, have been developed for protection against tera-ethyl lead compounds (Neoprene-Nylon fabric) nad acids (Neoprene-Fairprene). The latter has been tested and found resistant to 70 percent chlorosulfonic for at least 15 min., 60 percent Oleum, hydrofluoric acids, 70 percent nitric and 30 percent caustic soda solution.

Pulp From Hardwoods Goal Of Pilot Plant Operation

Pennsylvania hardwoods will be converted into pulp in a new semi-chemical pulping pilot plant of the New York & Pennsylvania Co. at Lock Haven, Pa., recently completed by Rust Engineering Co.

The pilot plant was designed to



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A-4140

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In a new acrylic process recently put on stream by the Rohm & Haas Company, Houston, Texas, a *Ro-Flo* gas compressor is handling a composite of hydrogen obtained from a low temperature distillation mixture of carbon monoxide and hydrogen. The new R & H process reduces the costs of methyl and ethyl acrylates — basic materials for synthetic organic chemicals.

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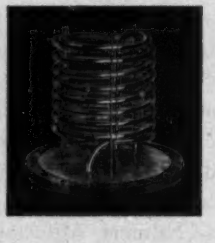

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produce pulp for the manufacture of high-grade paper. In addition to Pennsylvania hardwoods, the pilot plant can also utilize local softwoods. New York & Pennsylvania Co. is a manufacturer of high-grade paper.

The project included design and construction of a two-story concrete and cement block building, as well as a wood handling system, pulp mill and bleach plant.

While experimental in nature, pulp production of the new mill can be integrated with the New York & Pennsylvania Co.'s other units at Lock Haven, which consist of two paper mills and a pulp mill.

Du Pont Gets Out of Aromatics Business

Du Pont has sold its aromatics and compound business, as related to the soap, cosmetic, perfume and flavoring industries, to Rhodia, Inc., of New York. The sale did not include Du Pont's Alamask line of industrial reodorants.

Pointing up Du Pont's continuing interest in the Alamask products, new laboratory and production facilities will be provided at the company's Chambers Works, Deepwater Point, N. J.

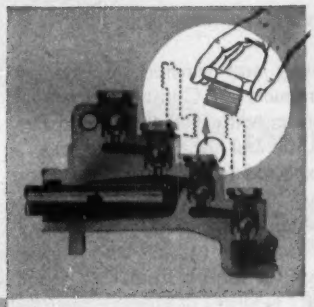
Du Pont will close down its New Brunswick, N. J., plant, where aromatics were produced, as this type of business was becoming more and more foreign to the company's main manufacturing interests.

Rhodia, Inc., is an affiliate of Rhone-Poulenc of France, prominent in the aromatic chemicals and perfume field for many years. Rhodia will manufacture these products in the United States under the direction of specialists from France. Rhodia foresees no break in operations during the transition period, and the business will be carried on in line with Du Pont policies of previous years.

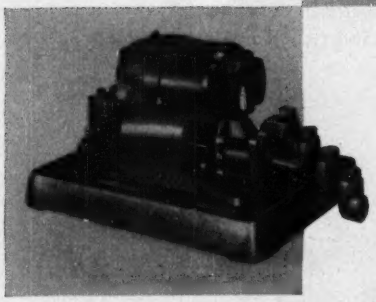
Platformer Being Built As Union Oil Expands

As part of its $40 million expansion, Union Oil Co. of California has awarded contracts totaling $5,750,000 for construction at its Oleum, Calif., refinery.

A contract with C. F. Braun & Co. calls for completion of a platformer by November 1954. This is a catalytic



Basic design simplicity of the *exclusive* Milton Roy liquid end step-valve assures high and reproducible volumetric efficiency. Inspection, servicing, or thorough cleaning of individual ball-checks and seats are effected without disturbing piping or other ball-checks and seats.



Two-to-One Service Life with this Milton Roy Pump

CONTROLLED VOLUME PUMPING

INSTRUMENTATION

PROCESS CONTROL SYSTEMS

BLENDING AND FORMULATING

On The Job for a leading chemical manufacturer, this Milton Roy Motor-Driven Controlled Volume Pump is still going strong after 4½ years of operation . . . has needed very little maintenance. A previously employed chemical feed pump, on the other hand, lasted only 2½ years, and required considerable maintenance.

Long service life is just one of many reasons why rugged Milton Roy Pumps are in wide use throughout industry. Wherever requirements call for precise metering of measured quantities of liquid in controlled volume, there's one of these versatile instruments to do the job. Capacity of each pump is variable from 0 to 100% by any one of several mechanical or automatic means of plunger stroke or speed adjustment.

Driven by motor, or powered by air, Milton Roy Pumps meter practically any liquid . . . in capacities from 3 milliliters per *hour* to 45 gallons per *minute*, against pressures up to 25,000 pounds per square inch. They are available as single or multiple units or as component parts of complete chemical feed and control systems. We invite your inquiries.

***New Bulletin No. 553** tells the complete story on Milton Roy Motor-Driven Controlled Volume Pumps and their application. Write for your **free** copy.*

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CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

Pocketsize Performance*

*22 in. x 25½ in.

. . . with big equipment accuracy . . . that's Sutton's new

***Whippet* V-80**

Specific Gravity Separator designed especially for small lot operations!

Now for the first time in separating equipment history here is a portable lab-size separator, incorporating all the inherent performance qualities of standard size machines. Now for the first time you can *economically* assay products for accurate "commercial yield" data *before* setting up full-scale processing operations.

There's a lot you'd like to know about Sutton's new *Whippet V-80*. There's a lot we'd like to tell you.

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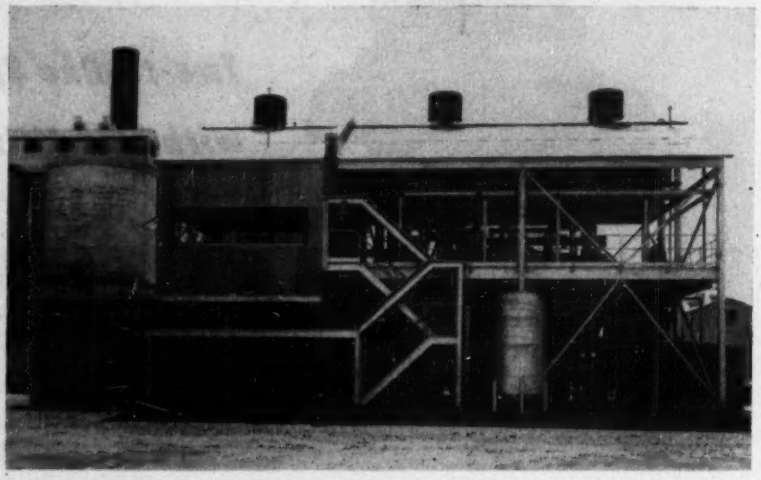
reforming unit licensed by Universal Oil Products Co. Construction on the platformer, with its daily feed capacity of 14,500 bbl. of gasoline stocks, is not expected to start until early next year.

Bechtel Corp. will construct exterior facilities, utilities and tankage required for the platformer operation.

Other facilities in Union's proposed $40 million expansion are a catalytic desulfurization unit, a coker, a sulfur removal unit and processing unit, a gasoline finishing unit and auxiliary facilities.

Earlier the company disclosed plans to spend $600,000 to add a catalytic reformer and other facilities to the Cut Bank, Mont., refinery it operates under license from Atlantic Refining Co. This work will be completed by September 1954.



HYDROGENATION at low pressure yields furfuryl alcohol in Memphis plant.

New Furfuryl Alcohol Plant

Furfuryl alcohol is now being produced at the Memphis, Tenn., plant of Quaker Oats Co. by a new catalytic hydrogenation process. The new plant, built at a cost of about $600,000, uses a continuous vapor-phase process. It has facilities for recycling excess hydrogen, as well as for catalyst regeneration.

Hydrogen is piped from a nearby plant producing it as a byproduct. Shipments of furfuryl alcohol are now being made from the new plant.

Furfuryl alcohol is used to make chemical-resistant resins, which in turn go into corrosion-proof cements and mortars, or are used in the manufacture of molded and reinforced tanks, kettles, fume ducts, pipes and similar chemical-resistant equipment.

Furfuryl alcohol is also used with urea-formaldehyde adhesives to improve craze resistance and improve the gap-filling properties of glue. In another resin use, furfuryl alcohol is employed as a reactive solvent in the manufacture of resin-bonded abrasive wheels. The furfuryl alcohol is a solvent for the resin used to bind the abrasive particles and then reacts with the resin during the curing cycle so that relatively little of it is lost through volatility.

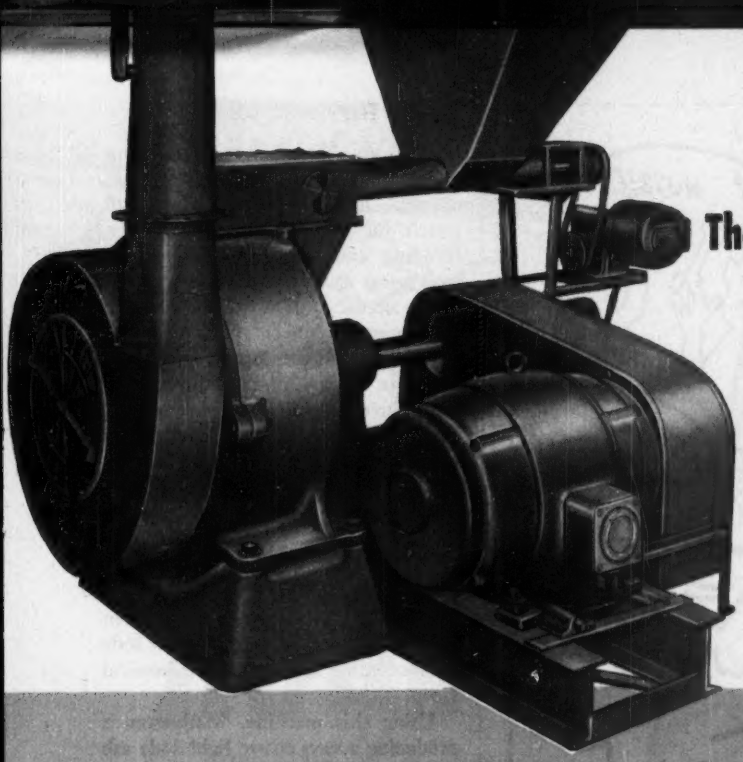
In the textile industry, furfuryl alcohol is also employed as a dye solvent and as a specialty solvent for materials that are difficult to dissolve.

Price of furfuryl alcohol made by the new Quaker process is 18.4 c. per lb. in tank car lots, f. o. b. Memphis.

Pilot Plant Will Explore Polyesters, Other Polymers

Expanding its interest in synthetic resins and polymers, Celanese Corp. of America is rapidly completing construction of its new plastics pilot plant at its Summit, N. J., research laboratories.

Closed-system continuous pilot units will be erected outdoors on a 50 by 100 ft. open concrete slab. In addition, a tall building will be con-



The new *Superfine*

SCHUTZ-O'NEILL PULVERIZER

backed by 60 YEARS *of experience*

AIR FORCE PULVERIZING—AIR CLASSIFICATION

Here is a proven, automatic and dustless method of pulverizing any grindable material to your desired fineness. For extremely fine grinding and uniform particle size distribution of product, the principle of centrifugal impact with air attrition utilized so efficiently by the Schutz-O'Neill "Superfine" Pulverizer has never been surpassed. The centrifugal force recirculates coarse particles within the mill for regrinding. The air classification carries the fine particles out of mill as uniform product of the desired particle size.

ADAPTABLE TO THE COMPLETE RANGE OF PULVERIZING FROM COARSE TO ULTRA FINE

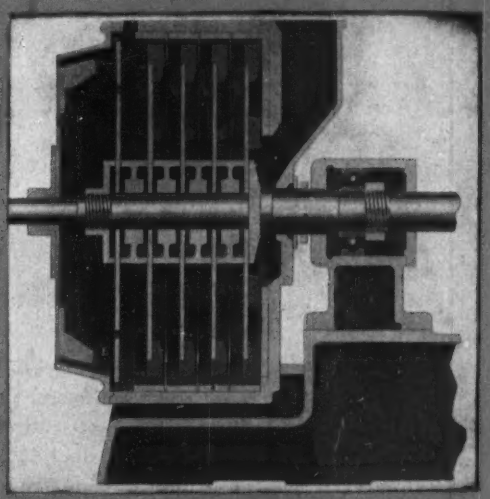
The ease of grinding and the versatility of the unit are two features not found in any other pulverizer on the market. With proper adjustments, this mill will produce particles from 40 mesh to low micron sizes under conditions that enable you to accurately control not only particle size but also the size distribution in the product. This can be done while maintaining grinding temperatures below 125-130°F. The mill is ordinarily set for fine powdering duty, but if a coarser product is desired, it can be readily obtained by proper adjustment in the grinding and classifying chambers.

COMES APART IN 10 MINUTES, EASY TO CLEAN, ADJUST, REPAIR

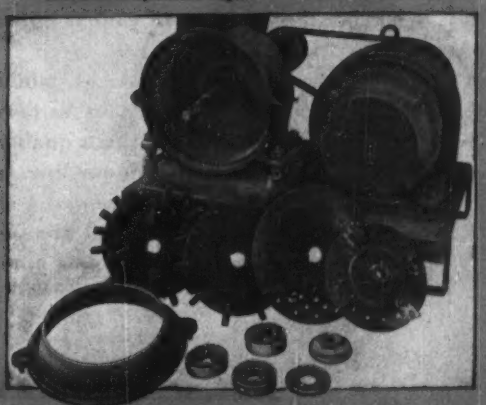
Ten minutes is all you need to take apart a Schutz-O'Neill "Superfine" for cleaning, to adjust for fineness, or replace any part. Remove 2 pins and cone housing lifts off. Loosen 1 set screw and 1 nut and all other parts slide right off the center shaft. It is unmatched for accessibility and simple, rugged design.

LET SCHUTZ-O'NEILL GRIND A TEST SAMPLE FOR YOU

Send us a 50 lb. stock sample stating what your material is and fineness desired. You will receive your pulverized stock plus our engineering report giving complete details of process used together with recommended equipment, methods and mill plans.



Cross section of the grinding chamber of our "Superfine" Pulverizer showing from left to right the cone plate, perforated mill plate and 4 beater plates with multi-section liner divided by annular rings.



Here is a disassembled mill. Every part separated and accessible—corrugated liners exposed for easy cleaning, exchange or replacement.

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HOW DID THE *nut* GET ITS NAME?

The word "nut" probably came into being like almost every other word in the language. Somehow, somewhere, sometime or other, somebody called a nut a nut (maybe it was the same guy who called a spade a spade). Whoever it was, someone else must have heard him say it, and decided to use the name too (which is a neat combination of name-calling and plagiarism). That started it. From there, the word caught on, and tradition did the rest.

Today, Allmetal—maker of stainless steel nuts, screws, bolts, and many other stainless fasteners—owes its good name to a tradition of high quality and fast service. If you need anything from our line, just give us the word.

Our 96-page catalog contains engineering data and weights as well as sizes and dimensions of stock items. If you want a copy, send us a note on your letterhead. Ask for catalog 53.

STAINLESS STEEL FASTENERS

ALLMETAL

SCREW PRODUCTS COMPANY, INC.

821 STEWART AVE., GARDEN CITY, L. I., N. Y.

structed on a 50 by 50 ft. foundation.

The building will house units that must be inclosed, as well as control panels for the outdoor pilot plants. Building and slab construction will each stress ease of expansion to meet future needs.

Celanese engineers plan to build experimental units in the new pilot plant for process and production research involving current Celanese plastics, such as polyesters, and new polymers.

Gyratory Sifter Produces Soda Ash for Glass Making

By using a machine familiar in flour milling for years, glass makers can save money in the manufacture of soda ash, according to Mathieson Chemical Corp.

Using this machine, Mathieson is producing a new coarse light soda ash product suitable for glass making. The new product, Mathieson believes, could eventually supersede "dense" soda ash heretofore generally used by glass plants.

To produce coarse light soda ash, Mathieson is completing a plant at its Saltville, Va., location that will produce 50,000 tons per year. It starts operating this fall. The new soda ash from this plant will be offered in bulk carload lots at $28 per ton f.o.b. Saltville.

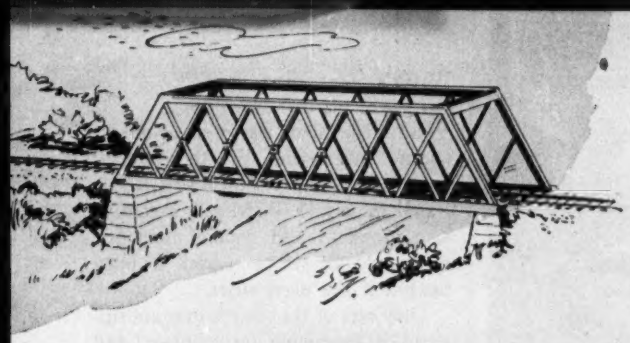
To further the development and make the product available to all glass makers, Mathieson has revealed that the new ash is made with a machine that has been used by the milling industry for years to sift flour. The device is a dynamically balanced gyratory sifter, and Allis-Chalmers furnished the sifters for the new soda ash plant at Saltville.

The coarse light ash has been used in the commercial production of glass, and large-scale tests in glass plants show it to have all of the necessary physical properties to make good glass.

After gaining operating experience in the new Saltville plant, Mathieson expects to install additional facilities for producing the new coarse ash.

Ferrochrome Now Made in Former Magnesium Plant

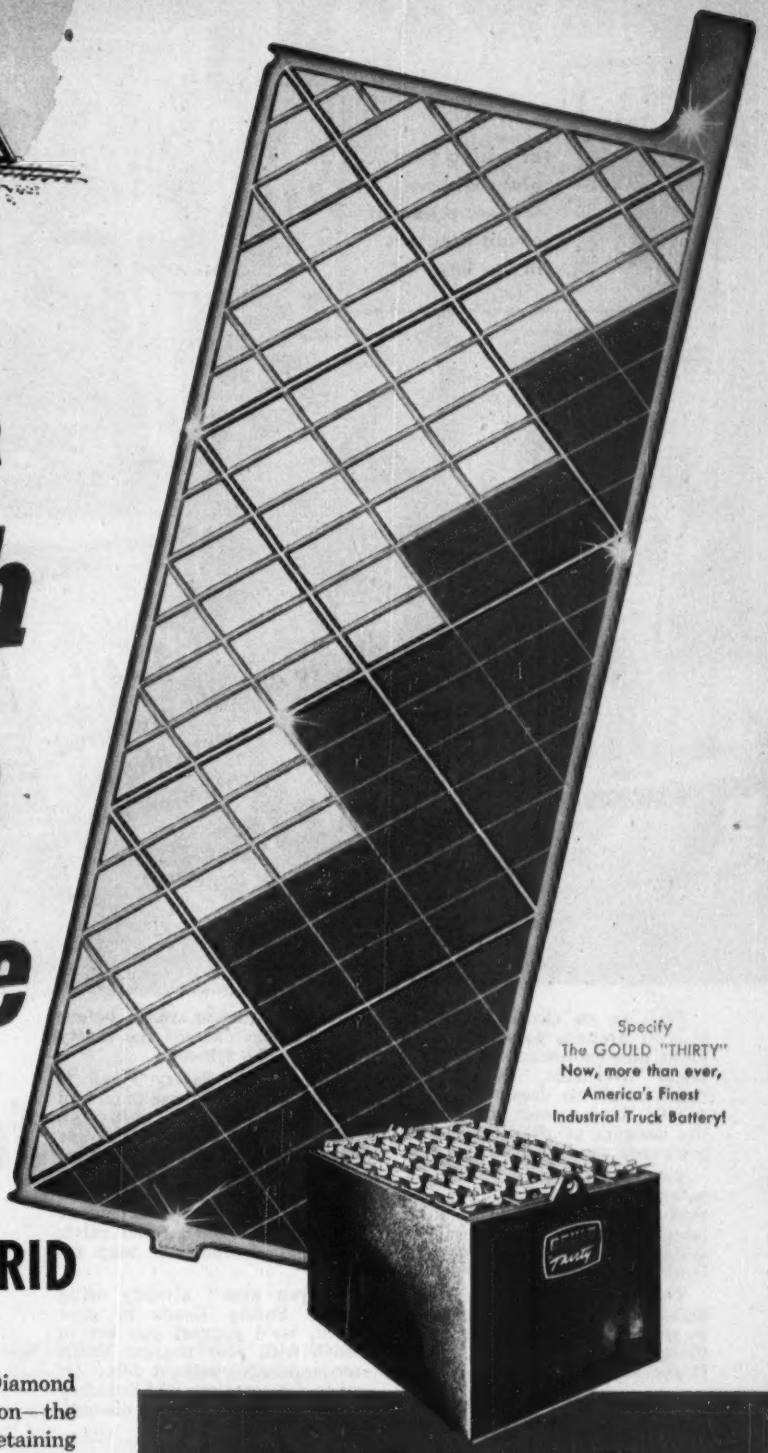
Production of ferrochrome has started at the Mead plant of Pacific Northwest Alloys, Inc., near Spokane,



BUILT LIKE A BRIDGE FOR

Rough Tough Service

New GOULD DIAMOND "Z" GRID



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The GOULD "THIRTY"
Now, more than ever,
America's Finest
Industrial Truck Battery!

LOOK at this illustration of Gould's new Diamond "Z" Grid. See the bridge-type construction—the husky diamond shaped active material retaining members. Note the *extra* large conductive members which not only conduct current to the lug with high efficiency but give still more strength to this most recent achievement of the famous Gould Laboratories.

Here's a grid that's built for rough, tough service, top performance and long life. Years ahead of requirements, it has *extra* strength for every application, *extra* ruggedness to withstand abuse, *extra* ability to deliver full power longer. Now more than ever—when you buy, buy Gould!

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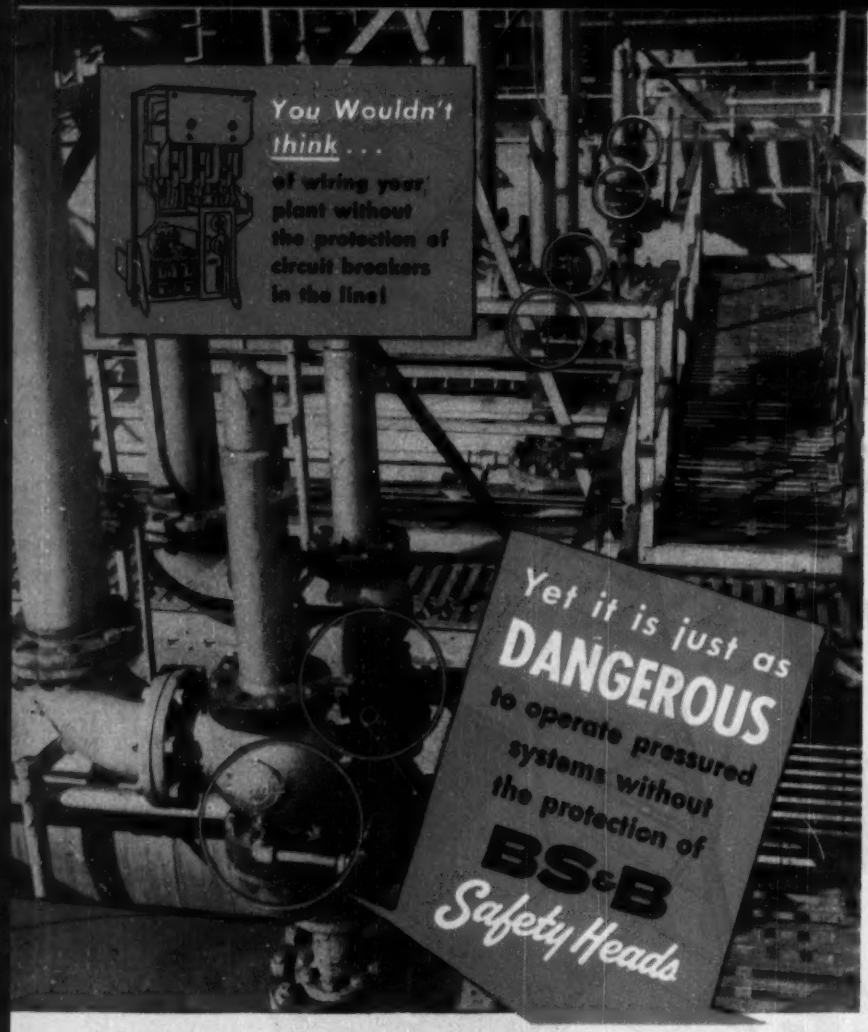
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of wiring your plant without the protection of circuit breakers in the line!
Yet it is just as DANGEROUS to operate pressured systems without the protection of
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Safety Heads

Just as an electrical circuit breaker protects your personnel, plant and equipment from electrical overloads, shorts and "burn-outs", so does the BS&B Safety Head protect them from the dangers of overpressure in pressured systems.

The BS&B Safety Head is a patented pressure relief device that is designed to become an integral part of any pressured system containing air, gas or liquid—either bland or corrosive.

The rupture disc of the BS&B Safety Head is custom fabricated to the specific requirements of the system of which it is a part. It provides a full pipe-sized vent for *instantaneous* relief before the pressure exceeds the safety limits of the system.

The BS&B Safety Head is especially suited to use in oil and gas producing fields, pipe lines, refineries, chemical plants, power plants and the refrigeration industry. It may be used as either a primary or secondary relief device, and either upstream or downstream from a relief valve, as varying conditions may require.

If you aren't already using BS&B Safety Heads in *your* plant, we'd suggest you get in touch with your nearest BS&B representative without delay. Or write for complete BS&B Safety Head Catalog. There's no obligation.

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SAFETY BS&B HEADS OVER 60 YEARS

WHAT'S HAPPENING, *cont. . .*

Wash. The plant was used to manufacture magnesium for the government before Pacific Northwest Alloys leased it, and H. B. Megill, executive vice president and general manager, says it can be switched back to magnesium if the need arises.

Only one of the plant's four arc furnaces is producing ferrochrome, and until additional vacuum capacity is installed the reduction plant will be able to treat the output of only one furnace.

The plant's ferrochrome production, using one furnace, will be about 1.5 million pounds monthly. Megill says one furnace will be kept producing ferrosilicon.

Petroleum Catalyst: Bay Chemical Co., a subsidiary of Morton Salt Co., has begun production at its new $2 million petroleum catalyst plant at Weeks Island, La. The new plant produces a silica-alumina catalyst from hydrochloric acid and steel slag residue. Capacity: 450 tons per month.

Dimer Acid: To meet increasing demand Emery Industries, Inc., of Cincinnati is expanding its plant for the production of its long-chain dibasic acid. Improved processing methods will produce a lighter colored product. Other characteristics of the polymerized fatty acid will remain unchanged.

TCP: Its output of tricresyl phosphate will be boosted more than 80 percent by Monsanto Chemical Co. as a result of production changes. Step-up was made to keep pace with the growing demand for tricresyl phosphate, both as the principal ingredient in TCP, Shell Oil Co.'s gasoline additive, and as a plasticizer in the manufacture of vinyl plastics. Monsanto, the world's largest producer of elemental phosphorus, also makes phosphorus oxychloride, principal tricresyl phosphate raw material.

Oxygen: Installation of a new oxygen generator in the River Rouge steel plant of Ford Motor Co. by Air Products, Inc., of Allentown, Pa., will increase Ford's high-purity oxygen producing capacity to 30 million cubic feet a month. Air Products leases four generators to Ford.

When you can't see for the dust...

SPECIFY KAISER ALUMINA!

IF alumina dust hampers your production and adds to your costs through excessive waste—*switch to Kaiser Alumina!*

Dust is minimized with Kaiser Alumina because the grains are *accurately sized* to meet specific applications. It's available in several sizes—from fine grades to coarse grades prepared for large bulk users. This careful sizing also insures *free flow* to help speed your operations.

This "tailoring" of alumina to customers' requirements was pioneered by Kaiser Chemicals. Such aggressive research on customer problems is another reason why Kaiser Chemicals has become a major supplier of calcined and hydrated aluminas, serving more than 80% of the nation's users.

Whether you manufacture abrasives, glass, ceramics, refractories, catalysts, or chemicals for water treatment, Kaiser Chemicals will give your order *immediate, individual attention*. Contact principal sales offices: Chemical Division, Kaiser Aluminum & Chemical Sales, Inc., Oakland 12, California; First National Tower, Akron 8, Ohio.

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Pro and Con

Engineers OK Refresher Series

Pro: Corrigan 100 Percent

Sir:

A thousand bravos for CE's "refresher course" series idea, and for Dr. Corrigan's par excellence opening article on thermodynamic principles.

The style of Dr. Corrigan's writing is magnificent, and should be noted by all technical educators. I never thought that "thermo" could be presented in such a painless manner.

My forecast is that CE's "refresher" series will set the technical journal world on fire with similar programs, and that your readers will demand a far more extensive and longer series than the present plans call for now.

A. Jung

Chemical Engineer

Bakelite Co.

Millburn, N. J.

▶ *Yes, reader reaction has been unanimously (over 96 percent, in fact) in favor of Corrigan's "refresher" series. Said one Corrigan fan in San Francisco: "It's a new idea in chemical engineering education that should put new life into a mighty lot of rusty curricula."—Ed.*

Pro: Physical Equilibria

Sir:

Please go ahead with the "refresher" series on Physical Equilibria. I like the "refresher" idea very much. . . .

Octave Du Temple

Argonne National Laboratories

Lemonte, Ill.

▶ *What not with the enthusiastic reception to Corrigan's refresher series from our readers, we're now planning to keep the series going until the whole field of chemical engineering fundamentals has been pretty well covered. Physical Equilibria should come in for attention before the end of next year.—Ed.*

Pro: Irishman Corrigan

Sir:

Tom Corrigan's an Irishman, God wot, as you point out in your September issue. For the man can sure swing his words around with the greatest of ease. That's rare for a chemical engineer, even for the Irish among them!

Seriously, you are to be congratulated for planning, initiating and publishing the Corrigan "refresher" series on chemical engineering fundamentals. The series has been badly needed.

Personally, I have felt the need for a good "refresher" for a long time. But I've never had the energy or initiative (or courage) to go back to my textbooks (which strike me as particularly pedantic now that I have been in industry for almost eight years). But Corrigan's article on thermodynamic principles was actually a pleasure to read. It put a real kick into a live subject!

James J. O'Leary

Development Engineer

Rochester, N. Y.

▶ *Our readers, too, have voted overwhelmingly for "more from Corrigan." The refresher series—something we've talked about for ten years or more—is already a success.— Ed.*

Pro: Refresher Reprints

Sir:

Your series of articles comprising a Chemical Engineering Refresher Course have aroused much interest among the staff in the Chemical Engineering Division here at A.E.R.E. Harwell.

To facilitate distribution for personal use within the Division we are intending to photostat the articles. However, if it is intended to publish the collected articles as a reprint at the conclusion of the course we should prefer this to making our own photostat collection. Would you please let me know if you intend a reprint.

W. H. Hardwick

Chemical Engineering Division

Atomic Energy Research Establishment

Harwell, England

▶ *Yes, indeed, reprints of this extremely popular section will be available. But they will be in sections. The first one, "Thermodynamics Principles," comprises the first three installments and may be ordered now from our Reprint Department at 50¢ per copy.—Ed.*

Sir:

I wish to express my opinion about the article started in the September issue of *Chemical Engineering* entitled Chemical Engineering Fundamentals: Thermodynamics Principles —I, by T. E. Corrigan.

Articles of this type are very helpful to all engineers who have been out of college only a few years to a large number of years. It helps them to review a subject without having to dig through hundreds of pages of textbooks plus the benefit that another author may cover the subject from a different approach, thus clarifying some parts that formerly may have been a little on the hazy side.

I hope that upon the conclusion of the series on thermodynamics another subject such as distillation, heat transfer, or fluid flow may be presented.

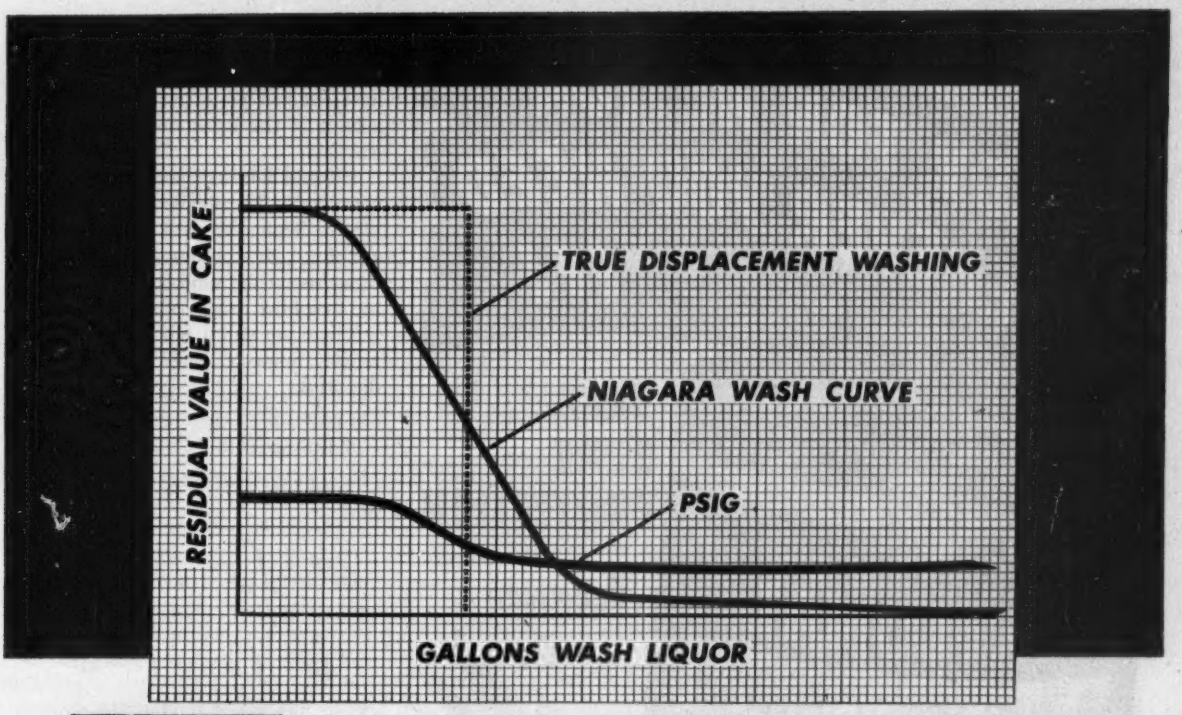
Myron K. Seward

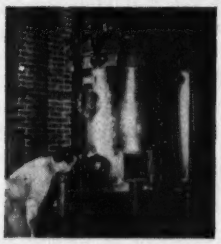
Wilmington Manor

New Castle, Del.

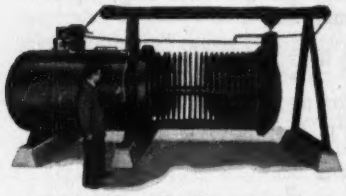
Sir:

May I add my compliments to those you must have or will receive on your Chemical Engineering Refresher Series. It will be invaluable to those who





FOR LIQUID CLARIFICATION Niagara Vertical Pressure-Leaf Filters are supplied in sizes handling up to 30,000 GPH. These filters are all-metal; leakproof; easily fabricated in stainless steel and other alloys; readily jacketed or lined to match your need.



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if you wash your filter cake . . .

this WASHING CURVE is good news for you

The curve shows what happens typically when you wash residual solvent or other liquid from the cake in a Niagara Pressure-Leaf Filter.

Notice how close this is to true displacement washing. Here's what it means in results:

You can wash 10% acid in mother liquor down to .01%, using only three volumes of wash liquor per volume of cake to get this high acid recovery.

Another example is vegetable oil. You can reduce 10% by weight of oil in the cake to .01% by solvent washing.

You can save as much as 1½ hours per cycle over conventional washing (or air blowing) methods.

You can cut recovery costs decisively. Roughly 50% less steam is needed for evaporation of wash liquor, since dilution is roughly 50% less than with other filters.

You can eliminate the cost and upkeep of a separate filter used only for washing.

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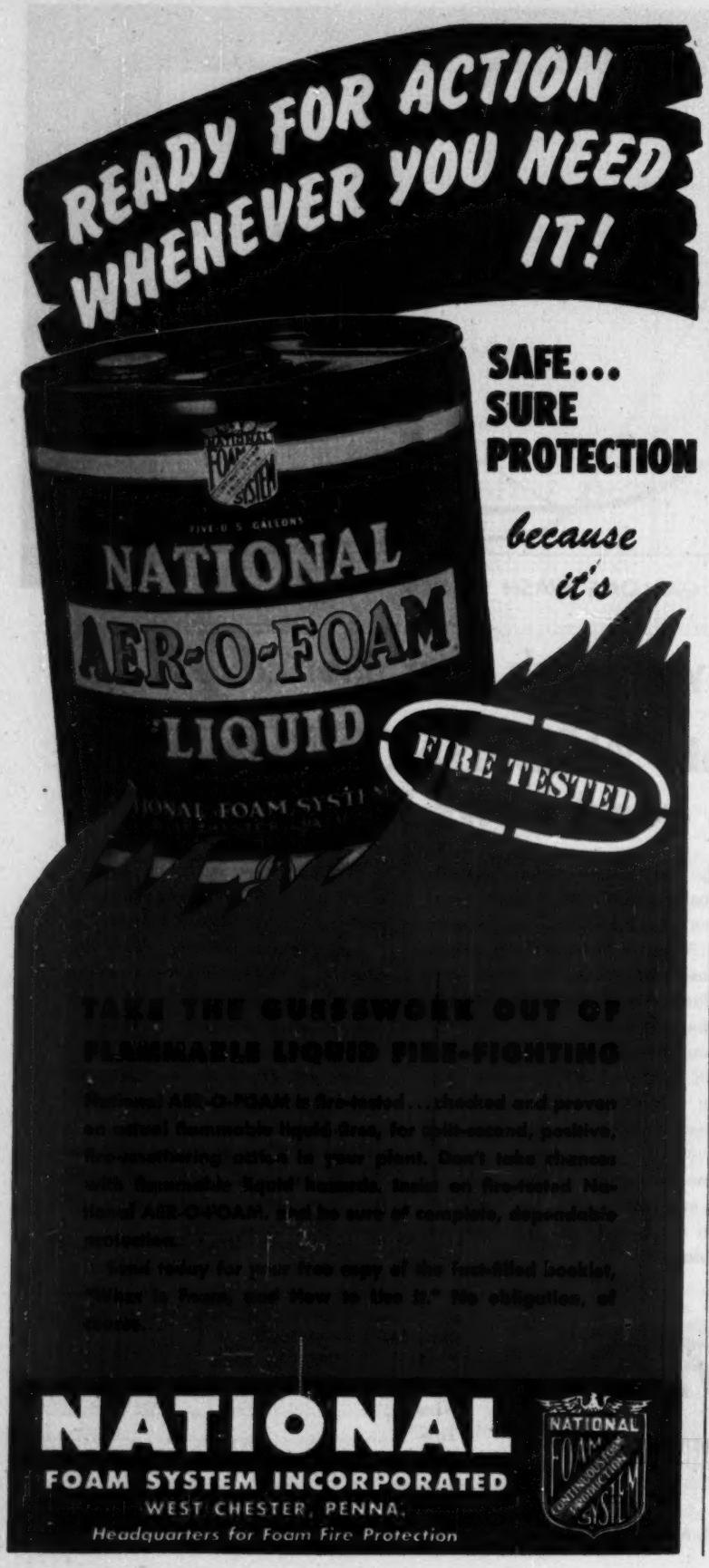


PRO AND CON, cont. . .

have not had the opportunity to keep abreast of the latest developments in the field.

I would like to comment that Dr. Corrigan's Thermodynamics Principles in September is a fine start. In addition to promoting neglected thoughts on the subject, it also forced me to a brief review of calculus.

There are still a few points in the article, however, that are somewhat doubtful.

On page 240:

Substitution of:

$$c_p = a + bT + cT^2$$

in:

$$AH = \int_{T_1}^{T_2} c_p \, dT$$

should yield: (I believe)

$$AH = \int_{T_1}^{T_2} (a + bT + cT^2) \, dT$$

On p. 241 the two-stage equation:

$w = (p_0 + p_1)(V_2 - V_3) + p_0(V_3 - V_1)$

should read:

$w = (p_0 + p_1)(V_2 - V_1) + p_0(V_3 - V_2)$

in which:

V_1 = volume at 10 atm.
V_2 = volume at 2 atm.
V_3 = volume at 1 atm.

In the equation as written in the article, the substitutions for V_3 are inconsistent and for V_1 and V_2 are identical. (The end result is correct, however, since the numerical values are actually in proper order).

On p. 241 the three stage equation should be:

$$w = (p_0 + p_2 + p_3)(V_3 - V_1) + (p_0 + p_1)(V_2 - V_3) + p_0(V_4 - V_2)$$

following the same reasoning as above.

On p. 242 substitution of:

$$V = \frac{RT}{p}$$

in:

$$w = -\int_{p_1}^{p_2} V \, dp$$

yields:

$$w = -RT \int_{p_1}^{p_2} \frac{dp}{p} = RT \int_{p_2}^{p_1} \frac{dp}{p}$$

$$= RT \ln \left(\frac{p_1}{p_2} \right)$$

This gives the proper result because:

p_1 = 10 atm. (V_1 = 35.9 cu. ft.)
p_2 = 1 atm. (V_2 = 359 cu. ft.)

Of course, if these errors were intentionally included to poll reader reac-

tion, please accept this as my contribution.

GEORGE M. BONNETT
Chemical Engineer
Newport News Shipbuilding and Dry Dock Co., Inc.
Newport News, Va.

► *For Corrigan's answer to reader Bonnett's calculus, see the brief letter that follows.—ED.*

Sir:

Mr. Bonnett was right in saying that the integral of the heat capacity equation should include the *dt* term at the end. This was, indeed, an oversight on my part.

Likewise, he was correct regarding the subscripts on the V terms. The reason for this was that the drawings were revised several times after the original manuscript was written and in one or another of these revisions the subscripts must have been changed around without the corresponding changes having been made in the descriptive part.

These errors were not put in to draw reader comment, and so I appreciate Mr. Bonnett's calling them to our attention.

THOMAS E. CORRIGAN
Chemical Engineer
Mathieson Chemical Corp.
Niagara Falls, N. Y.

Sir:

I have just finished reading the September issue of *Chemical Engineering* and I want to compliment you on your new "Brush-Up" series. It is certainly a good idea, and I trust you will follow through with it.

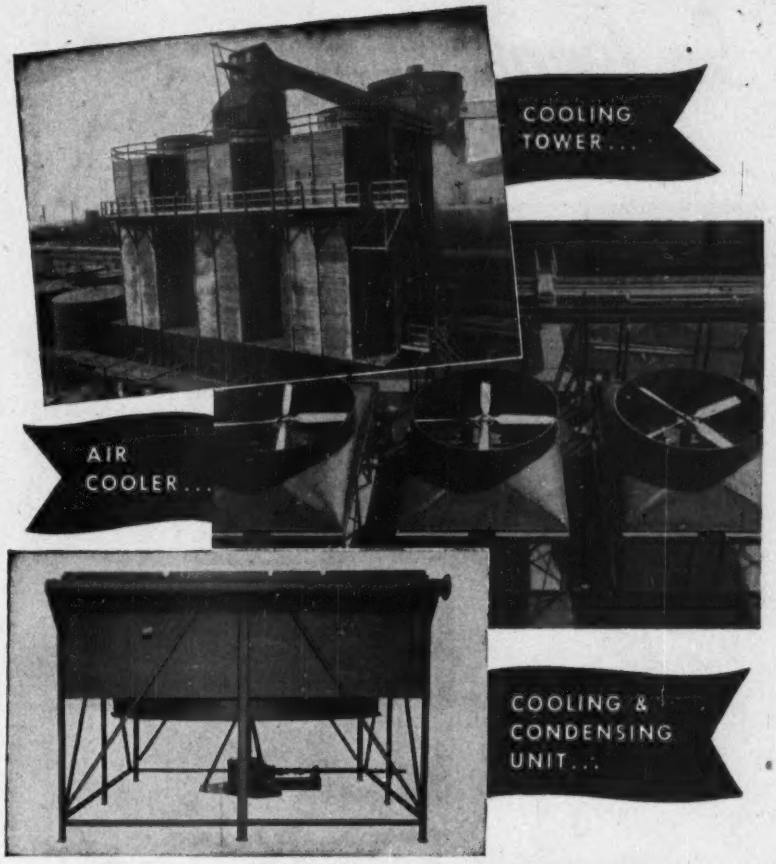
As you suggested, I extracted this article to save. Have you ever tried to remove an article from the center part of the magazine without losing the left-hand part of the sheet?

Therefore, I should like to ask why you do not perforate those sections liable to be saved.

D. B. MONCRIEF
Carbide & Carbon Chemicals Co.
Institute, W. Va.

► *As for an easy way to clip and save the Refresher articles, we refer Reader Moncrief to Dale Davis' "Rule of the Sharp 6-H Pencil" (see letter that follows).*

Yes, we considered perforations for the series so that they could be saved easier. But the Post Office people tell us we would lose our second-class mailing privileges—and just about triple our postage from 26 cents per copy to around 75 cents per



Whatever the installation, it pays you to Specify Aeromaster Fans

Practically every manufacturer of cooling units in this country has used Aeromaster Fans as original equipment! There are many reasons for this choice. Aeromaster Fans are an adaptation of high-speed aircraft propellers—precisely prebalanced, with an easily adjustable blade pitch to meet changing power requirements. They give you top efficiency and improved anti-flutter performance . . . require less horsepower to operate.

Aeromaster blades are protected against mild acids and alkalies, abrasion, all weather conditions, by a special *Aeroloid* blade coating, exclusive with Aeromaster. Aeromaster Fans are fully guaranteed . . . many models, ranging from 5 to 24 ft. diameters, with 4, 6, or 8 blades per fan—capacities up to 1,000,000 cfm. As original equipment or for replacement, Aeromaster Fans are tops for long-lasting, reliable operation at less cost!

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This Koppers Division also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators and Gas Apparatus. *Engineered* Products Sold with *Service*

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Gentlemen: Please send me detailed information on Aeromaster Fans for
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Name_____
Title_____ Company_____
City_____ Zone_____ State_____

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MAKING penicillin and other antibiotics requires carefully engineered equipment. From this assortment of vats and filters, piping and valves come "wonder drugs" that lengthen your life span.

E. R. Squibb & Sons Laboratories at New Brunswick, New Jersey, make these vital antibiotics. Here Squibb uses special automatic process control equipment made by the Fischer & Porter Company that includes many Lebanon CIRCLE L castings. To maintain the "Reliability, Uniformity, Purity and Efficacy" of these Squibb products, each CIRCLE L casting must be thoroughly sound and unaffected by the concentrated caustic and sulphuric acids present in the manufacturing process.

In difficult services, services where perfection in material and workmanship are demanded, Lebanon CIRCLE L castings have established remarkable records.

You should see—STEEL WITH A THOUSAND QUALITIES—37-min. 16 mm, full-color sound film on the making of steel castings. For information write: Dept. F, Lebanon Steel Foundry.

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CARBON, SPECIAL ALLOY AND STAINLESS STEEL

LEBANON STEEL FOUNDRY LEBANON, PA.

PRO AND CON, cont. . .

copy (postage alone would then be three times the yearly subscription price). There're an awful lot of things—obvious things—we don't do because of P. O. regulations!—ED.

How to Tear Out Pages . . .

Sir:

Here's a very simple—but also extremely practical—little trick on how to tear pages out of magazines. One might doctor up an old O. Henry quatrain to describe the situation:

"Scissorization is vexation,
Penknives are as bad;
This problem perplexes me,
But pencils make me glad."

Anyway, here's the trick I've used successfully to remove many, many pages from *Chemical Engineering:*

Draw a straight line with a sharp 6-H pencil down the page near the bound edge, then tear along the line. Results: excellent, fast, neat.

Scissors cannot be used satisfactorily near the bound edge of the paper; a knife usually burrs up the paper and causes an irregular tear; most people lack the time or the tools to take out the wire staples. But the pencil method does it!

D. S. DAVIS
Professor of Chemical Engineering
Virginia Polytechnic Institute
Blacksburg, Va.

► *A nifty trick, this, and one we're glad to pass along to all CE readers who've had trouble tearing out and filing pages.*—ED.

Pro: Our Changes

Sir:

My purpose in writing the present letter is to compliment you on the improvement in your magazine. I have been in Canada for the last year and have not seen *Chemical Engineering* regularly.

I have just finished reading one of your recent issues and I was greatly impressed. It is always trite to say, "My, how you have grown!" but the expression is apropos in this case. Congratulations. . . .

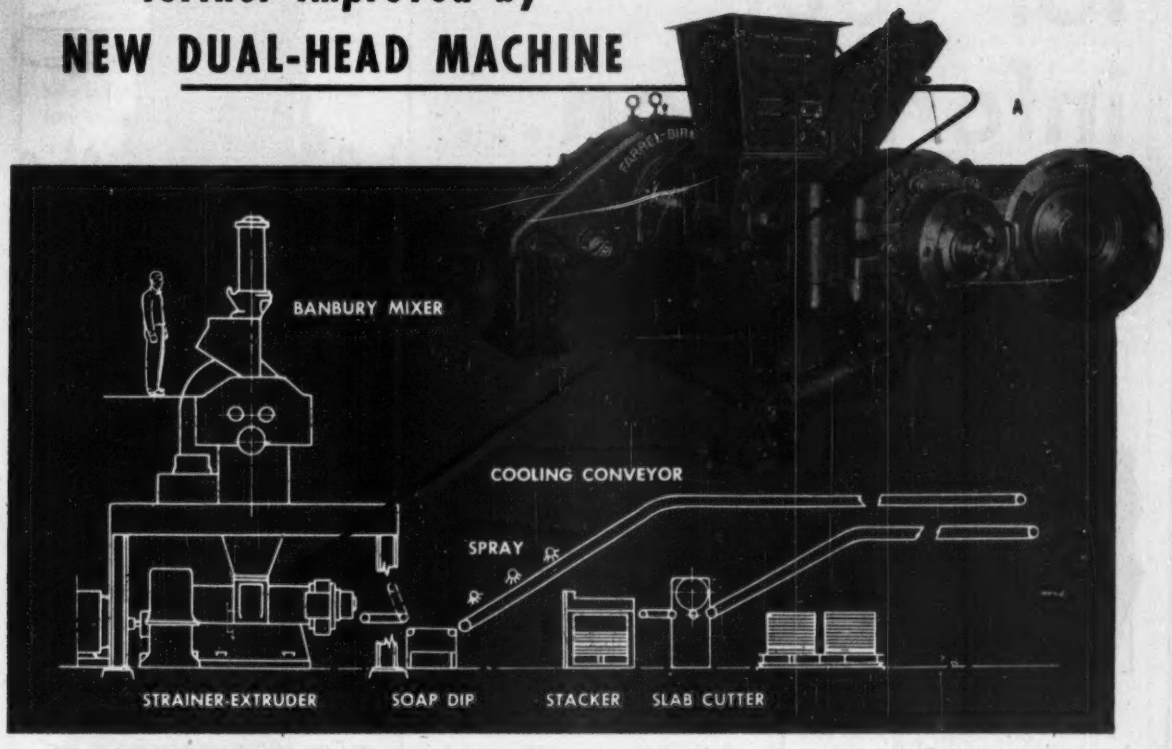
HUNTER NICHOLSON
Dale Chemical Industries, Inc.
Los Angeles, Calif.

► *We're always glad to hear such remarks, but all the changes we've been making in Chemical Engineering have been suggested by our readers. Our aim is to make CE more interesting and more valuable to all our 38,000 subscribers throughout the chemical process industries.*—ED.

STRAINER-EXTRUDER SYSTEM

further improved by

NEW DUAL-HEAD MACHINE



Three years ago, Farrel-Birmingham announced the development of the strainer-extruder system shown in the above diagram. Now, with a new dual-head machine available as optional equipment, the system becomes even more versatile and efficient.

In this system, the combination strainer-extruder takes the Banbury batch (either direct from the mixer or by conveyor), strains it or extrudes it, or both. With a cooling conveyor incorporating a dip unit, slab cutter and stacker, material from the Banbury* mixer is automatically strained, extruded, soaped and stacked in neat piles.

The two or three men required by a conventional system are no longer needed. The Banbury operator controls the entire process. Not a pound of stock is lifted or carried manually.

The new strainer-extruder has two hinged heads of breechlock construction which are hydraulically operated to make change-over easier. One head is for straining and has a circular die to deliver the stock in a tube which is slit at the die exit to form a continuous slab of the stock. The second head extrudes the stock as a flat strip, without straining.

Farrel-Birmingham extruders are built, either with or without strainers, in sizes to handle the output of any production size Banbury mixer. These machines, although similar in general features, are specially designed to suit your exact requirements.

Send for further information about extruders to meet your exact needs, or for complete details of the Farrel-Birmingham strainer-extruder system.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONNECTICUT FB-828

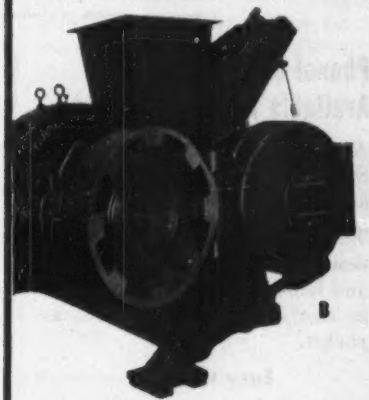
Plants: Ansonia and Derby, Conn., Buffalo, N. Y.

Sales Offices: Ansonia, Buffalo, New York, Akron, Chicago, Los Angeles, Houston

Farrel-Birmingham®

*Trade mark of Farrel-Birmingham Co., Inc.

A (Above) New dual-head strainer-extruder with combination straining and circular die extruding head in position. Stock is strained and then extruded in a tube, which is slit at the die exit.



B Here the strainer head has been swung out of the way, and the flat strip extruder head placed in position.

for your information...

brief summaries of helpful product news

SIMPLIFIED METHOD FOR PRODUCING CORTISONE DEVELOPED BY MONSANTO RESEARCH TEAM

A simplified method for producing cortisone from common chemical raw materials has been developed by Monsanto's Organic Chemicals Division Research Department.

In the report covering this new method of preparation, Monsanto research personnel described the synthesis of *dl*-cortisone acetate from an intermediate known as Woodward's tricyclic ketone in 17 steps. The process developed by Monsanto does not require rare reagents, and good yields are reported.

Previous to the development of this new method, cortisone was produced by a complex process from such naturally occurring raw materials as ox bile.

It was emphasized by Monsanto that large quantities of synthetic cortisone will not be available immediately. Laboratory findings will have to be translated into full-scale plants capable of producing the synthetic hormone in commercial quantities.

Phenol Handling Booklet Available from Monsanto

A new 32-page booklet, "The Safe Handling of Phenol," is now available from Monsanto.

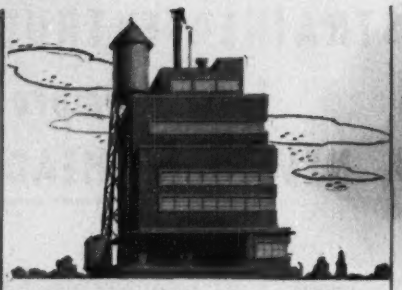
This booklet has been carefully designed to be both informative and handy to use. It is compact in size and slips easily into a pocket.

Easy to read

All reading material, while authoritative, is easy to read and understand. Monsanto's artist has come up with some lively illustrations and the company's phenol plant technologists have made sure this booklet contains all the pertinent facts.

Here you'll find complete information on unloading tank cars, unloading small containers, sampling, transferring, storing and other subjects.

The coupon brings you a copy by return mail. Send it in now.



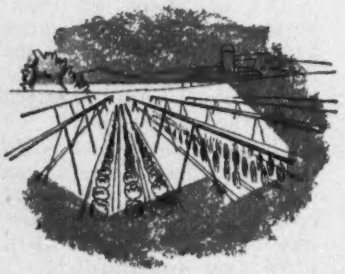
Plant Output Increased 80% With Monsanto Santicizer 160

Recently the owner of a vinyl extrusion plant, in a southern state, was faced with a major problem: *How to increase production most efficiently?*

He called in Monsanto technical and sales personnel. They went into his plant . . . worked side by side with his technicians. They varied fillers and screw speeds, replaced one monomeric and one polymeric plasticizer with Santicizer* 160. Their recommendations produced these results:

- Production capacity increased 80% with *no increase in equipment.*
- Cost of raw materials cut *one cent per pound.*
- Smooth surface and trueness of contour fully maintained.
- No loss in tensile strength, softness, low-temperature flexibility or other important properties.

For more information on fast-processing Santicizers 160, 140 or 141, mail the coupon today.



2,4-D Butyl Ester Available

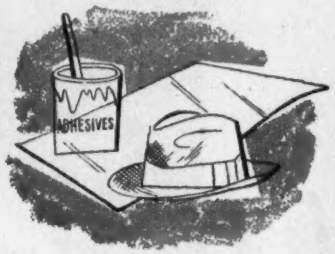
Monsanto is now offering 2,4-D butyl ester to the agricultural chemicals trade. In addition to butyl ester, the company continues the production of 2,4-D acid and 2,4-D isopropyl ester.

Santolite Resins Aid Cellulose Ester Formulation

Monsanto makes two aryl sulfonamide formaldehyde condensation resins which meet most of the exacting requirements of specialty formulations of cellulose esters.

These two products, Santolite* MHP and Santolite MS-80%, are outstanding for use in spray lacquers; cellophane coatings for heat sealing, moisture proofing and mold resistance; adhesive formulations and straw hat lacquers.

Both Santolite resins meet the most important processing requirements of compatibility with cellulose nitrate and absence of any noticeable color.



Other advantages include:

- Good stability when exposed to light.
- Ability to increase retentivity of cellulose acetate for plasticizers.
- Low-viscosity solutions.
- Compatibility with vegetable proteins and with polyvinyl acetate resins.
- Ability to increase flexibility and toughness of ethyl cellulose.

Use the coupon for more information.

Wetting Agents Speed Reaction In Fertilizer Manufacture

One of the most recent technical advances in the fertilizer industry is the use of wetting agents as a processing aid in the manufacture of both superphosphates and fertilizer mixed-goods.

These wetting agents, Monsanto Sterox* AJ or Santomerse* No. 1 Spray Dried, speed up the reaction by allowing more complete and quicker mixture of fertilizer ingredients.

Santomerse No. 1 Spray Dried has, for over two years, proved outstanding in the conditioning of fertilizer mixed-goods.

Monsanto's Sterox AJ is extremely effective in superphosphate manufacture. Added to the acid in proper concentration, it reduces the surface tension of the acid and causes it to mix more thoroughly with the phosphate rock. Result: a quick cure and a homogenous superphosphate free of hard lumps. For details of these aids to fertilizer process mail coupon for your copy of the article entitled "Wetting Agents for Fertilizer Manufacture."

Tolylene Diisocyanate Ideal For Many New Applications

MONSANTO tolylene diisocyanate is rapidly gaining increased popularity as an important ingredient in foamed-in-place resins and in polyurethanes.

The polyurethanes have been found to be of great utility in the field of metal-to-metal adhesion, metal-to-glass adhesion, surface coatings of high abrasion and chemical resistance, and films for dielectric uses in capacitors, wire coatings, etc. These applications are described in the new Bulletin P-151.

Tolylene diisocyanate also produces foams which may be predetermined to be either rigid or flexible. These foams are of interest because they can be foamed in the intricate space where they are desired.

The flexible isocyanate foam, a new product to American industry, shows great promise in the fields of transportation seating, bedding, etc.

The general bulletin on these products is Number P-125; foam resins, P-144; rubber adhesives, P-145; and polyurethanes, P-151.

Monsanto Phosphates Now Unitized for Shipment

Monsanto sodium and ammonium phosphates can now be unitized for shipment at no cost to the customer. When requested, pallet-size paperboard bases are placed under each unit, normally comprised of eighteen 100-lb. bags. These units can be loaded and unloaded by standard lift trucks with thin forks. When placed on regular pallets these paperboard-based units may be stacked for warehousing. This method of material handling greatly cuts truck and car unloading time. For example, a 54,000-lb. car can be unloaded with a fork-lift truck in two man-hours as compared with twelve man-hours normally needed for manual unloading. Talk to your Monsanto Phosphate representative about the advantages of this new service.

MONSANTO CHEMICALS — PLASTICS

*Reg. U. S. Pat. Off.

MONSANTO CHEMICAL COMPANY 11/53
1703 South Second Street, St. Louis 4, Missouri

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☐ Santicizers 140, 141, 160

Please send: ☐ Phenol Handling Booklet
☐ "Wetting Agents for Fertilizer Manufacture" Booklet
☐ Bulletin P-125 Isocyanates
☐ Bulletin P-144 Isocyanate Foamed-In-Place Resins
☐ Bulletin P-145 Isocyanate-Based Adhesives
☐ Bulletin P-151 Polyurethanes and Their Use as Adhesives

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Combined trip-throttle valve permits operator to throttle steam directly into G-E Type DP Mechanical-Drive Turbine, usually eliminating need for extra valve in steam line.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Combined Trip-throttle Valve Cuts Turbine Installation Costs

To save you the cost both of buying and installing a throttle valve in the steam line, General Electric designed into its standard Type DP mechanical-drive turbine a trip valve which also functions as a throttle valve. This feature alone can save you up to $200.00 at time of installation.

The combined trip-throttle valve controls steam admission to the turbine on starting and also shuts off all steam in case of overspeed. No need in most cases to shut off steam valves ahead of the turbine before restarting the unit. The combined trip-throttle valve can quickly be reset and the turbine put back on the line, saving you time in an emergency.

THIS COMBINED TRIP-THROTTLE VALVE is just one of many DP features which save you money. The chart below indicates other areas of savings.

Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features to save you extra costs. For more information contact your nearest G-E apparatus sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric Company, Schenectady 5, N. Y. 252-63

GENERAL ELECTRIC

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THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save You up to
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SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
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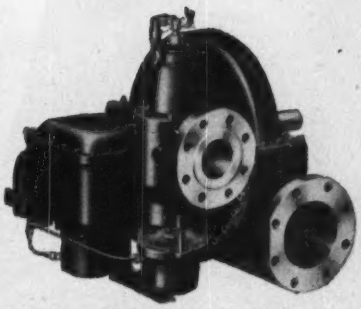
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00



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EVALUATE ALL THE COSTS

See why G-E standard Type DP turbines are your most economical buy.

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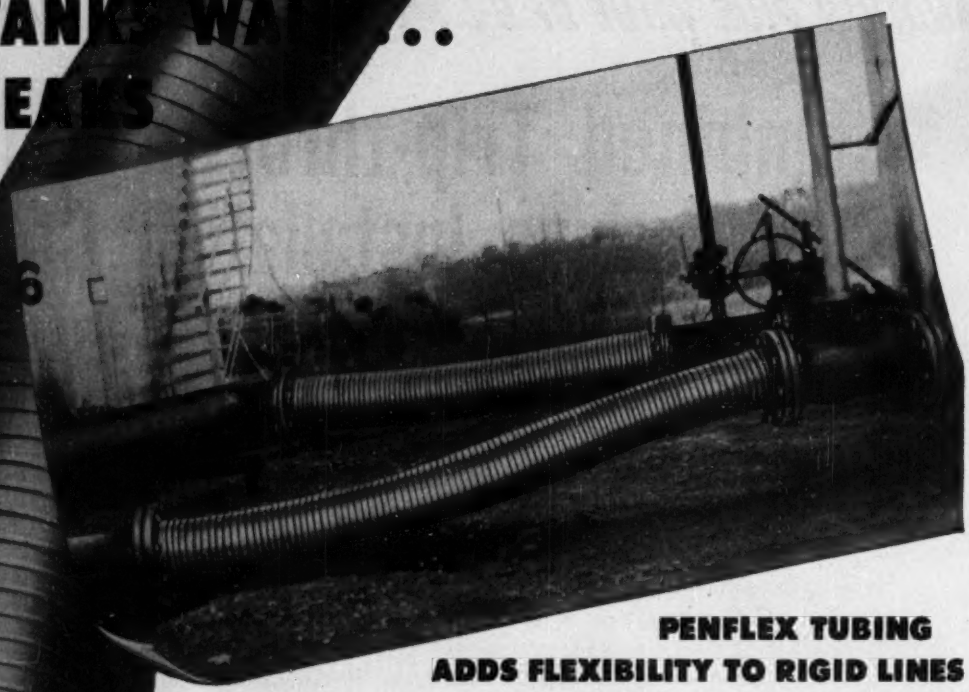

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Large storage tanks must move with the heat or cold. Rigid connections on one installation were constantly breaking. Flammable liquids leaked out . . . a fire hazard was created, material lost and maintenance costs rose.

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In the petroleum or the chemical industries wherever the conveying of liquids, gases or granular materials for storage tanks, engines, compressors or other types of equipment is necessary with flexibility you'll find Penflex "Flexineering" has the answer. Penflex manufactures a complete line of four-wall interlocked and seamless welded corrugated flexible tubing . . . metallic hose, tubing or couplings from 1/8" I.D. and up . . . automatic barrel fillers, accessories and fittings.

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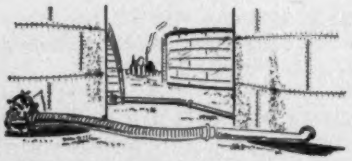

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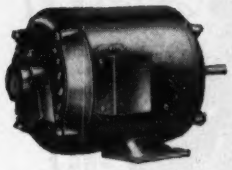
From the Wide Range of Types of ... in Sizes From 1/3 to 400 Horsepower



SINGLE PHASE:

Split Phase Induction—⅓, ¼, ½ H. P.

Capacitor—⅛ to 20 H. P.
Repulsion start, brush lifting, induction—½ to 7½ H. P.

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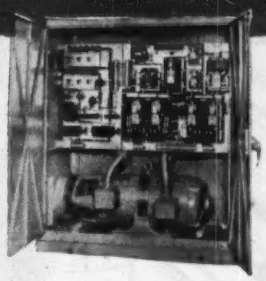
Split Phase 1-5P1
Capacitor 1-1P3
Repulsion Start 2-1P1



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A complete line of adjustable speed drives for coordinating all kinds of production processes.

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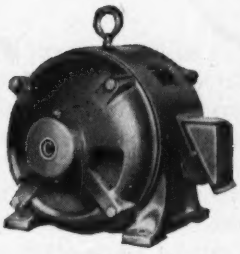

POLYPHASE:

Squirrel Cage Induction—⅓ to 400 H. P.

Wound Rotor Motors—1 to 400 H. P.

Synchronous Motors—20 to 150 H. P.

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Squirrel Cage, Drip Proof—6-1P1
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Squirrel Cage, Enclosed Fan Cooled—6-1P41
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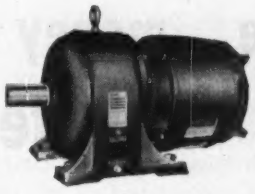
Wound Rotor—6-3P1
Synchronous—6-5P1



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⅛ to 15 H. P., single, double and triple gear reduction.

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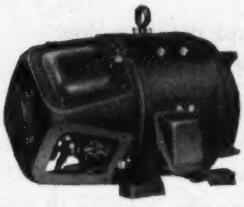

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All capacities—⅛ to 300 H. P.

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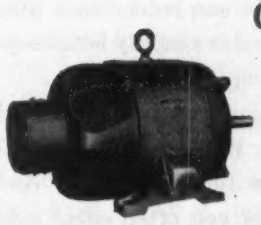

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AC, .63 to 250 KVA
DC, .75 to 200 KW

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CE-825R

Motors listed above are available in Open Rated Drip Proof, Splash Proof, Totally Enclosed Fan Cooled and Explosion Proof frames—and with a dozen different methods of mounting. They are unusually quiet starting and running and unusually free from vibration.

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When you combine all your steel requirements on a single order to Ryerson you cut costs in many ways. One call—one order—save purchasing time and you also simplify bookkeeping—reduce clerical expense.

In addition, combining most carbon steel purchases under the Ryerson quantity differential plan brings further savings. And with larger quantities you often effect substantial reduction in freight on long hauls.

All these economies are possible when you call Ryerson for steel because Ryerson stocks are the world's largest and most diversified. Carbon steel, alloys, stainless—no matter what analyses you need, no matter what shapes and sizes, you can be practically certain of getting them all with just one call to Ryerson.

You can be sure of prompt delivery, too. So next time you need steel, no matter how many kinds or sizes, call your nearest Ryerson plant.

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CARBON STEEL BARS — Hot rolled & cold finished
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PLATES—Many types including Inland 4-Way Safety Plate
SHEETS—Hot & cold rolled, many types & coatings
TUBING—Seamless & welded, mechanical & boiler tubes
ALLOYS—Hot rolled, cold finished, heat treated
STAINLESS—Allegheny bars, plates, sheets, tubes, etc.
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Chemical Engineering
DECEMBER 1953

A Big Week in Philadelphia

NEXT week will be a big week in Philadelphia. For on November 30 this year's "Chem Show"—the 24th Exposition of the Chemical Industries—will open its doors at Convention Hall.

Chemical people from all over the country will flock to see the "biggest" Chem Show ever. More than 500 exhibitors will display and demonstrate their products—many for the first time—to a steady stream of idea-seeking engineers, researchers, management and production men. This year's attendance may well top 40,000.

Chemical engineers have long contended that nothing can quite match the Chem Show in providing concentrated opportunities for first-hand contacts with new developments in processing equipment, services and raw materials. For the engineer looking for technical information, this year's 500 or more exhibits will serve to stimulate new ideas, new contacts, new solutions to old problems.

For one full week, Philadelphia's Convention Hall thus becomes the market place for technical know-how to the chemical process industries of the entire nation.

Another big event in Philadelphia next week will be the dinner at the Bellevue-Stratford on December 2 at which Carbide & Carbon will receive the 12th Award for Chemical Engineering Achievement.

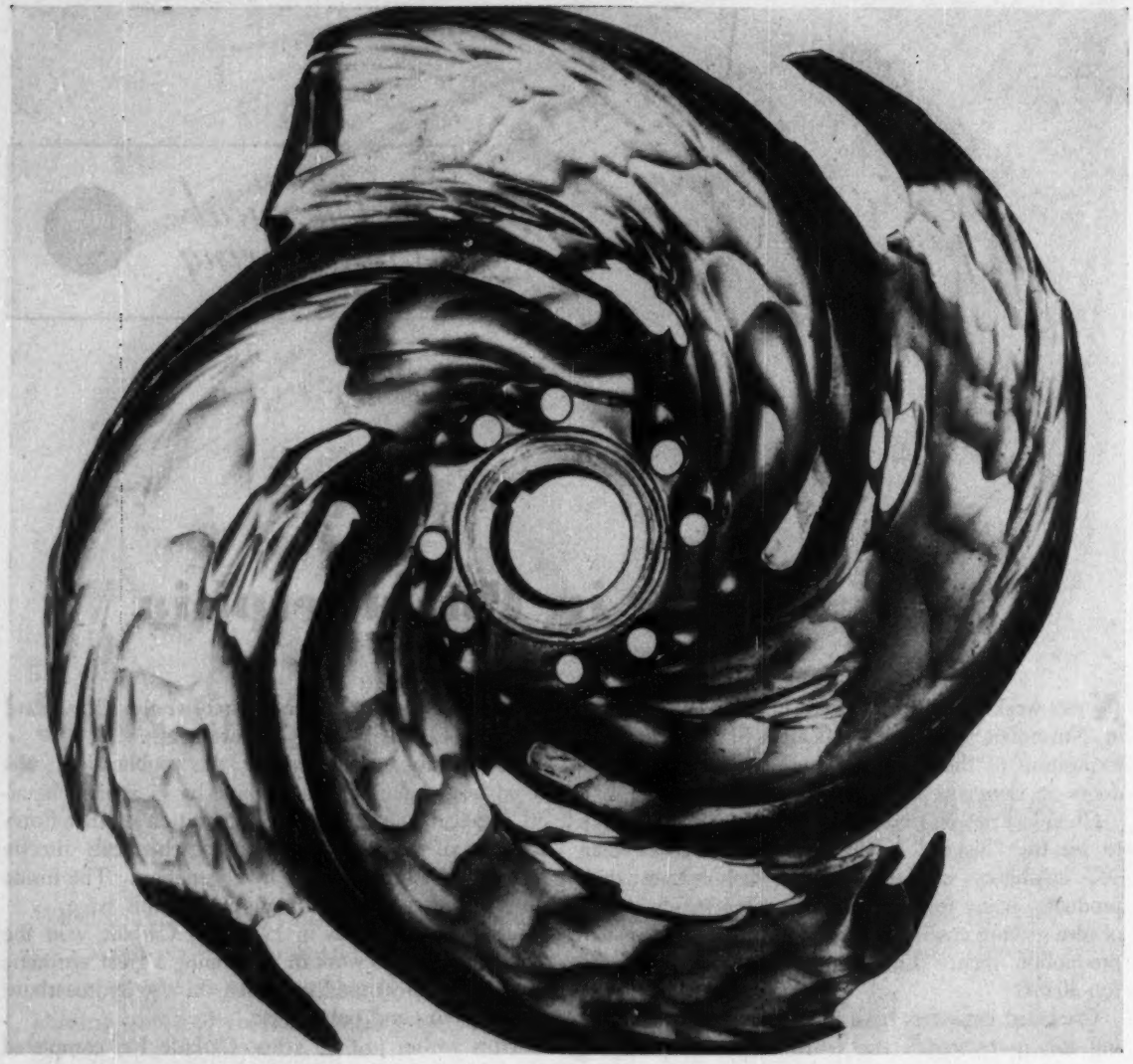
The Award, sponsored by this publication, was voted overwhelmingly to Carbide by 77 senior chemical engineering educators in recognition of that firm's commercial production of aromatic chemicals directly from coal by high-pressure hydrogenation. The inside story of this achievement appears in this issue.

Significantly, it was in 1933 that Carbide won the first Award for its work in developing a great synthetic organic chemical industry based on the hydrocarbons of petroleum and natural gas.

Thus within just 20 years, Carbide has completed the cycle from aliphatics to aromatics, from petroleum chemicals to coal chemicals—an enviable record of pioneering achievement in the two vital segments of the synthetic organic chemical industry.

No doubt about it, next week will be a big "chemical" week in Philadelphia!

John R. Callaham



Cut Impeller Erosion—Easily

T. W. EDWARDS

"We order these pumps of special alloys, conservatively expect a life of three years and within six months they're useless. Look at that impeller." Such was the reaction of the maintenance engineer.

The unit in question, a centrifugal slurry pump, had been forced to operate far below its design capacity and now, without warning, it had failed. The impeller bore evidence of severe erosion. Vane tips were completely destroyed; the shroud was badly worn. It was no longer possible for the pump to attain its normal pressure and capacity.

Why did this happen? The answer was quick in coming. Low capacity operation set up internal recirculation within the pump and, with solids present, failure was alarmingly rapid.

T. W. EDWARDS *is an application engineer in the Centrifugal Pump Division of the Worthington Corp.*

PITFALLS IN PUMP SELECTION

However, don't blame the process engineer for selecting the wrong pump. He very reasonably based his selection on an extreme flow rate which was sometimes necessary, but not encountered in normal operation. And, of course, there could have been other reasons why the original selection went sour.

Between the pump ordering stage and the actual operating stage of a particular process changes often occur in the process flow which are not accurately reflected in the selected equipment. Compounding of contingency items and safety factors also leads to overdesigning which is not

apparent until the unit is onstream. Then it is too late to do anything but severely throttle the discharge valve.

Moreover, solids in the slurry may be of such size that, in order to provide internal openings large enough to pass them, it is necessary to select a pump hydraulically oversized. In such cases, the purchase of standard units frequently leads to excessively strong head-capacity characteristics—especially where the design head is already padded with safety factors.

BY-PASS ARRANGEMENT

The simple, yet effective, by-pass arrangement shown here will alleviate these difficulties, and preserve the safety factors so desirable for continuous duty conditions.

By-passing to the suction tank allows the pump to operate at its maximum capacity as determined from the intersection of the pump characteristic curve and the system head curve, and from its net positive suction head (NPSH) requirements*. This minimizes the internal recirculation.

A further advantage to this arrangement is that visible evidence of pump wear is easily discernible to the operator. Initially the quantity of slurry by-passed will be high. Then, as erosion progresses, it will be necessary to close down on the by-pass in order to preserve proper process conditions.

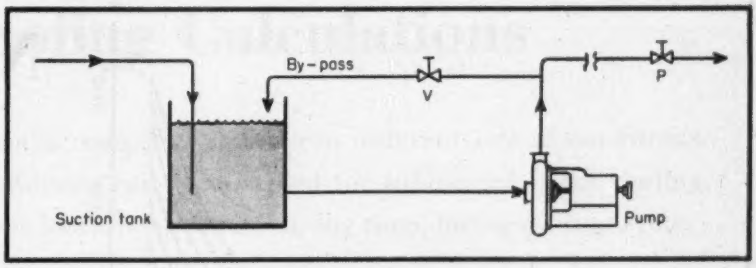
So long as there is flow through the by-pass line, some margin of safety exists. This should warn the operator well in advance of actual pump failure, allowing ample time for procurement of replacement parts and normal maintenance scheduling.

To do this, the by-pass line should terminate well above the liquid level in the suction tank. For convenience in indicating the general arrangement, the by-pass is shown terminating just above the pump suction. This specific location must, of course, be avoided as air bubbles would easily enter the suction line and induce air binding.

In an actual installation, the by-pass line would end as far from the pump suction as possible, and baffles would be installed to prevent the air-laden liquid from short-circuiting directly to the pump.

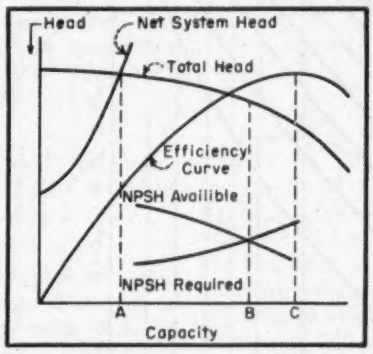
*For more on NPSH and system head curves see pp. 85 and 91 of "Pump Questions and Answers," by Carter, Karassik and Wright, McGraw-Hill Book Co., Inc., New York.

By-Passing Is the Simple Solution

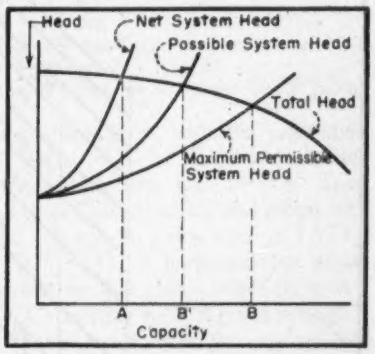


Low capacity operation of centrifugal pumps induces internal recirculation of liquid within the pump and, when solids are present, speeds impeller erosion. With this simple by-pass arrangement, the pump can be operated at its maximum capacity—thus reducing internal recirculation and slowing erosion.

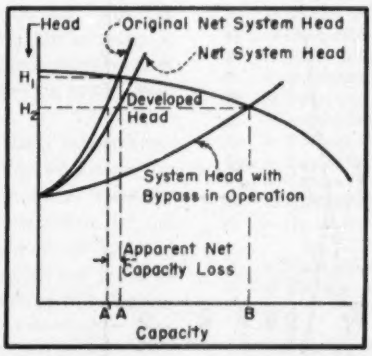
What Happens When You By-Pass



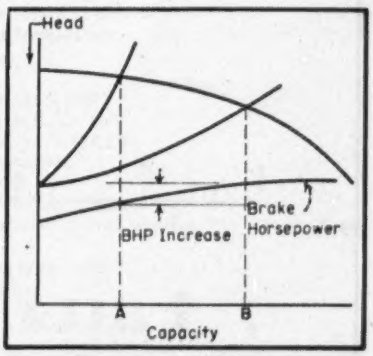
Typical condition of a centrifugal pump operating at a net capacity A, which is only 25 percent of that corresponding to the best efficiency C and about 30 percent of the maximum permissible capacity B. Under these conditions erosion of the pump parts is excessively severe.



Throttling and pipe size control the intersection of the characteristic curve with the system head curve. Although this can occur at almost any point, wear is reduced as the maximum efficiency is approached. At B' wear is still excessive; adjustment to B gives optimum results.

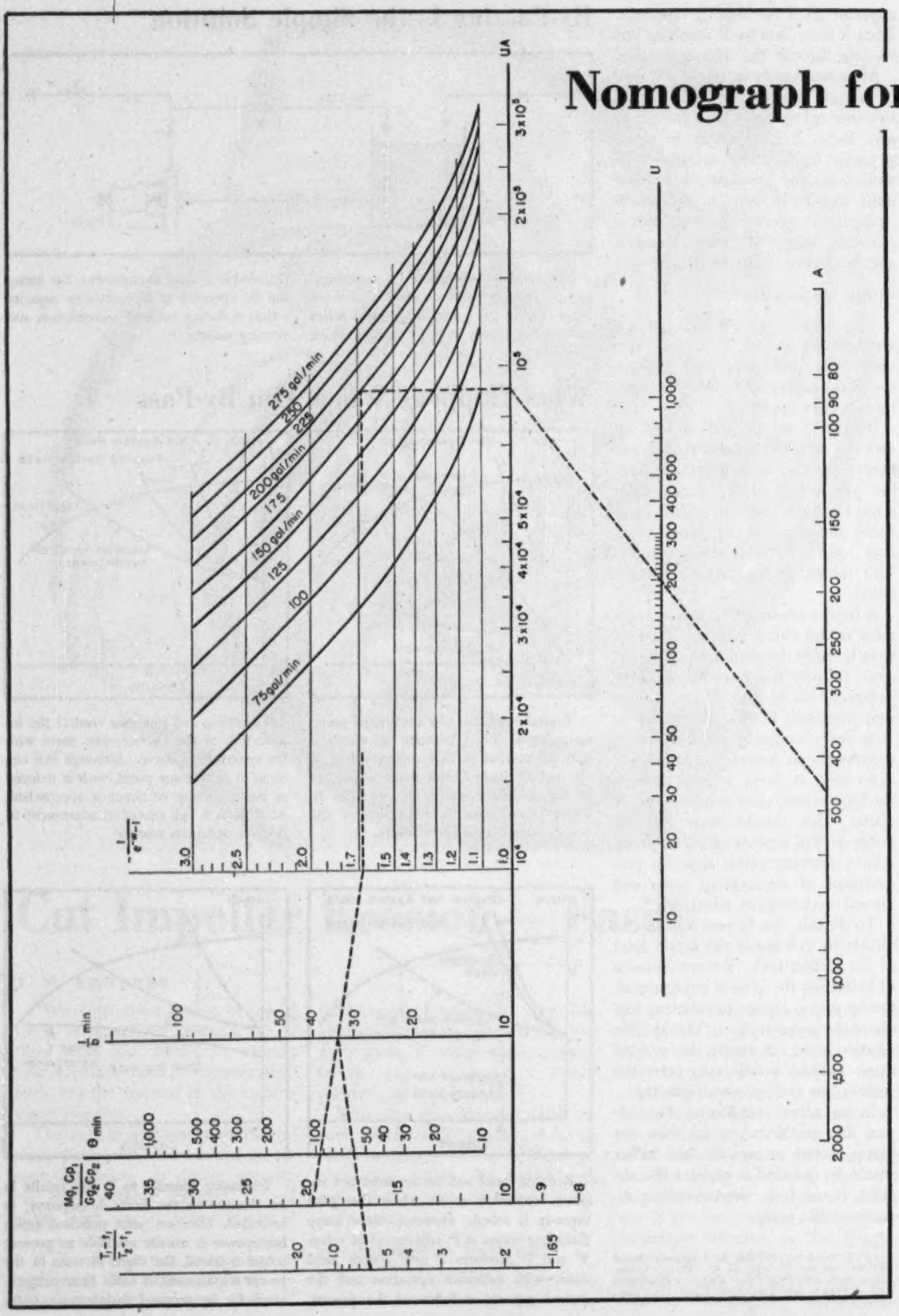


Reduced head and an apparent net capacity reduction result when the gross capacity is raised. However, since some throttling occurs at P, adjustment of valves V and P produces a new system head curve—with optimum operation and the desired pressure and flow at the process.



Increasing capacity to B also results in an increase in the brake horsepower, as indicated. However, since sufficient motor horsepower is usually available to prevent actual overload, the slight increase in the power requirement is more than compensated for by reduced maintenance costs.

Nomograph for



Easy Batch Cooling Calculations

- **Permits comparisons between different sets of conditions.**
- **Establishes coil area needed for submerged batch cooling.**
- **Gives batch temperature at any time during cooling cycle.**

MARCIAL FERNANDEZ SECO

Evaluation of cooling for liquid batches involves an analysis of heat transfer under conditions of unsteady state. Kern[1] developed a method for calculating the cooling time based on a known heat transfer area. Troupe[2] calculated the area required to cool a liquid batch in a given time interval.

Troupe's evaluation was established on the basis that in a liquid batch being uniformly chilled the temperature follows an exponential curve of the form $Y = Ae^{-b\theta}$. Applied to batch cooling this curve takes the form

$$T_2 - t_1 = (T_1 - t_1)\, e^{-b\theta}$$

It is possible to derive an expression which agrees completely with this equation. At the same time it enables one to see the physical parameters affecting b.

$$1/b = -(g_1\, M\, Cp_1/Cp_2\, g_2\, G)\ /(e^{-W} - 1)$$

A nomograph derived from this equation provides a rapid means for solving batch cooling problems. First step in constructing the nomograph was to draw scales for determining $1/b$ given $(T_1 - t_1)/(T_2 - t_1)$ and θ. Next, scales were drawn for obtaining $-1/(e^{-W} - 1)$ using previously determined value for $1/b$ and known value $(g_1\, M\, Cp_1)/(Cp_2\, g_2\, G)$.

The scale for $-1/(e^{-W} - 1)$ serves as the ordinate used with a UA abscissa scale for plotting curves for various rates of coolant circulation. Rates shown on the curves correspond to the use of water coolant. If another coolant is used the equivalent water rate must be calculated for use with the water curves. This is derived from the expression $(g_2\, G\, Cp_2)/8.33 = G$ equivalent in water.

Last step in constructing the nomograph consisted of drawing axis U and axis A so that A may be found from values of UA and U.

Use of the nomograph permits making comparisons between different sets of conditions. Various circulation rates can be compared and the most economical selected.

While the nomograph can be used to establish the coil area required for submerged cooling of a liquid batch it also can serve to give batch temperature at any point in the cooling cycle. Values needed for making this determination are surface area of coil, coefficient of heat transfer, coolant rate and volume of the liquid batch.

To illustrate use of the nomograph dotted lines are shown for solution of the following example:

M = 4,000 gal.
G = 200 gpm.
θ = 60 min.
T_1 = 200 deg. F.
T_2 = 100 deg. F.
t_1 = 80 deg. F.
U = 200 Btu. per sq. ft. per deg. F. per hr.

Graphing of this problem starts with the calculation that $(T_1 - t_1)/(T_2 - t_1) = 6$. A line drawn through this value and $\theta = 60$ establishes $1/b = 33.4$. Then $(g_1\, M\, Cp_1)/(Cp_2\, g_2\, G) = 20$ is calculated and joined with the point 33.4 on the $1/b$ scale to give a value of 1.67 for the expression $-1/(e^{-W} - 1)$. A horizontal line drawn from this point intersects the 200 gpm. coolant curve at a UA value of 91,000. Connecting the UA point through a U value of 200 establishes the A value for required coil area as 455 sq. ft.

Solution of the problem by Troupe's method gives a required area of 451 sq. ft. The error of 0.9 percent can be attributed to imperfections in the drawing.

NOMENCLATURE

- T_1 = Original liquid temperature.
- T_2 = Liquid temperature at time θ.
- t_1 = Inlet coolant temperature.
- θ = Time in min.
- b = A constant.
- M = Total gal. in liquid batch.
- g_1 = Liquid density, lb. per gal.
- g_2 = Coolant density, lb. per gal.
- Cp_1 = Liquid specific heat.
- Cp_2 = Coolant specific heat.
- G = Coolant circulating rate, gpm.
- U = Over-all coefficient of heat transfer, Btu. per sq. ft. per hr. per deg. F.
- A = Heat transfer area, sq. ft.
- W = $UA/Cp_2\, g_2\, G$.

MARCIAL FERNANDEZ SECO *is a chemical engineer with Shell Argentina Ltd., Buenos Aires, Argentina.*

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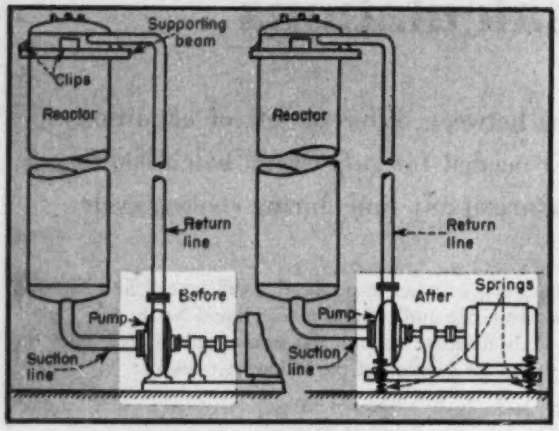
1. Kern, D. Q., "Process Heat Transfer," McGraw-Hill Book Co., New York, (1950).
2. Troupe, R. A., Chem. Eng., Sept. 1952, p. 128.

The Plant Notebook

Edited by Theodore R. Olive



Pump Trouble? Maybe Thermal Expansion Is Causing Misalignment

ROLAND P. LOEWEN, *Chemical Engineer, Chattanooga, Tenn.*

★ **September Contest Prize Winner**

We were operating a series of batch reactors. These were vertical tanks about 15 ft. high and some 3½ ft. in diameter. They had a network of pipe connections at the top and were supported by clips near the top.

Our method of operation was to dump in a charge of one of the raw materials and start a centrifugal pump that circulated the batch out the bottom and into the top of the reactor. Then other raw materials were added and the reaction proceeded. The temperature increased appreciably to a controlled maximum.

The sketch above, at the left, shows how the circulating pumps were installed. All lines were heavily jacketed. The suction lines were short.

One of the less pleasant regular duties of the operator was to pack the pumps and he usually didn't do it unless the packing leaks were pretty bad. Even after a dozen years of tolerating the situation we never quite got used to it. Periodically there would be bitter words between operating and maintenance supervisors about the quality of pump repairs and pump operation.

Finally, as the result of one of these discussions, one brain was agitated into action. It was suggested that the considerable heating of the equipment during use would result in enough expansion to cause misalignment of the pump.

As a remedy the master mechanic devised the spring support shown in the right-hand sketch. When the unit was started and heated to operating temperature the deflection of the spring pump mounts was startlingly visible to the eye. The pump was packed once during the first week, compared to once each 8 hr. before. Needless to say all other units were floating on springs before the end of the second week.

Heat Transfer Coefficients for Heating or Cooling in Tubes

Y. S. TANG, *Engineer, General Chemical Div., Allied Chemical & Dye Corp., Camden, N. J.*

Although various experimental works on the heating and cooling of fluids inside tubes have been reported in the literature, the empirical curve of Sieder and Tate[1] is generally used to determine the heat transfer coefficient.[2,3] Like most heat transfer data this curve is plotted as a dimensionless group j_H, against the Reynolds number Re. Here j_H is the product of two other dimensionless groups, the Nusselt and Prandtl numbers, to the $-\frac{1}{3}$ power, multiplied by the ratio of viscosities $(\mu_w/\mu)^{0.14}$. The last factor expresses the effect of the non-isothermal flow inside the tube, but for most fluids it can be assumed as unity. The use of these dimensionless groups makes the curve a general correlation and enables it to cover a wide range of variables.

However, it is usually found that such a correlation will not give a direct reading of the heat transfer coefficient from known variables (such as tube diameter, flow velocity or operating temperature) without cumbersome operations of multiplication, division or the manipulation of fractional powers. A simplification of design procedures is highly desirable in present-day engineering work. A simplification of this sort has been made in the graph (p. 175) by incorporating the j_H curve and transforming the individual variables into the dimensionless groups by use of nomographic principles. The chart enables the heat

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★ **October Contest Prize Winner**

"Control by Both Pressure and Temperature Improves Fractionator Performance."

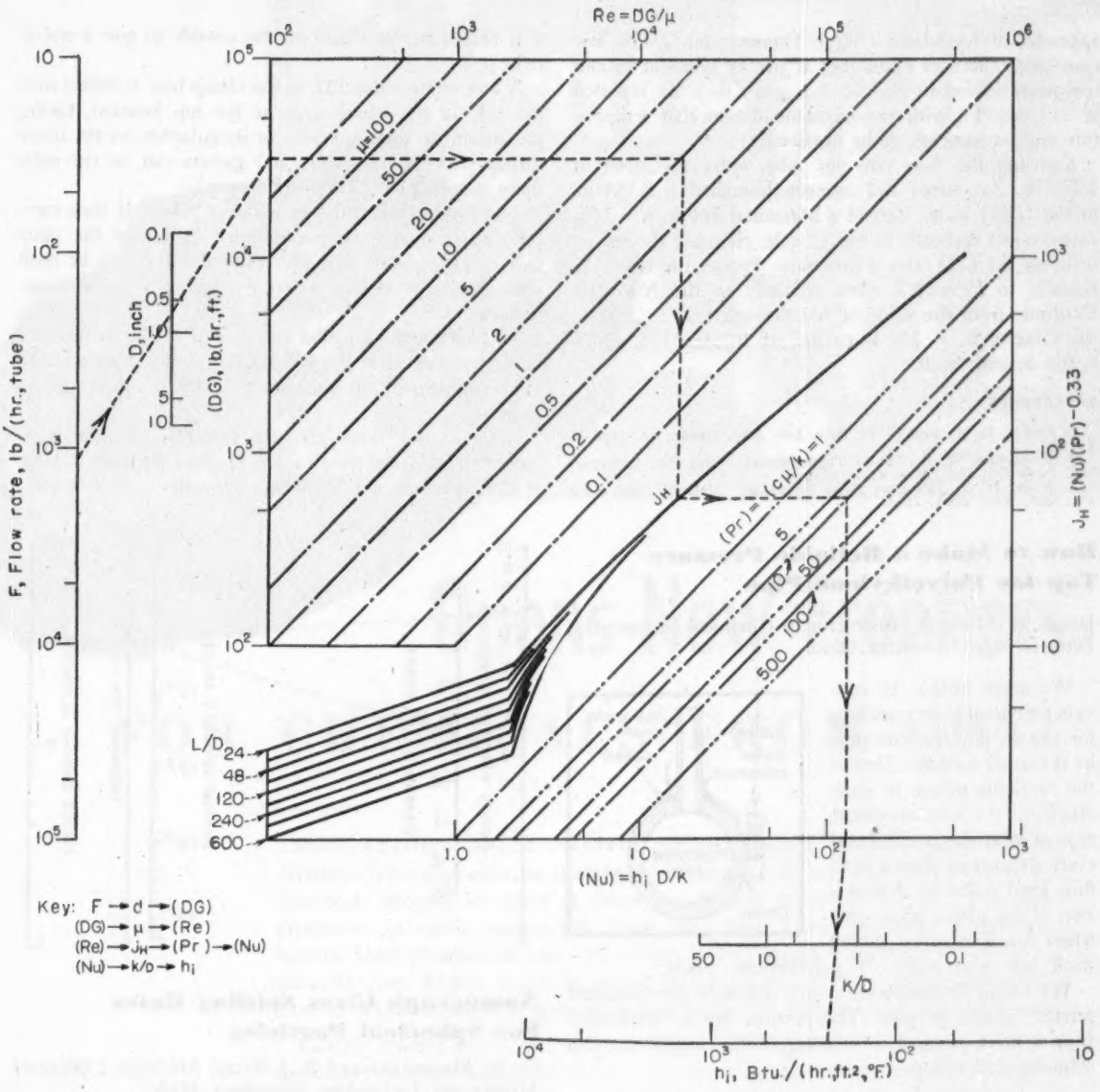
A prize of $50 in cash will be awarded to Leonard Steber, engineer with the E. R. Squibb & Sons division of Mathieson Chemical Corp., New Brunswick, N. J. His article will appear in the January issue.

$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for publication in the Plant Notebook. Each month's winner will be announced the second following month and published the third following month.

$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article, which will then be awarded an additional $100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Articles which are acceptable but are not winners will be published at regular space rates ($10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.



transfer coefficient to be obtained with minimum use of calculation.

Another advantage of the chart is that it permits an easy comparison of the effect on the heat transfer coefficient of changing the individual variables, an important consideration in the design of equipment.

NOMENCLATURE

- c Specific heat, Btu./(lb., deg. F.).
- d Diameter of tube, in.
- D Diameter of tube, ft.
- F Flow rate per tube, lb./(hr., tube).
- G Mass velocity, lb./(hr., sq. ft.).
- h_i Heat transfer coefficient, Btu./(hr., sq. ft., deg. F.).
- j_H Dimensionless group, $(Nu)\ (Pr)^{-0.33}\ (\mu_w/\mu)^{0.14}$.
- k Thermal conductivity, Btu./(hr., ft., deg. F.).
- L Tube length, ft.
- Nu Nusselt number, h_iD/k.
- Pr Prandtl number, $c\mu/k$.
- μ Viscosity, lb. mass/(ft., hr.) = centipoises × 2.42.
- μ_w Viscosity corresponding to tube wall temperature.

Problem—Use of the chart is best illustrated by an example. What is the coefficient of heat transfer h_i inside the tubes, in a two-pass heat exchanger with acetic acid heated inside the tubes? The acid flow is 168,000 lb./hr. Its entering and leaving temperatures are 90 and 150 deg. F., respectively, and the average temperature is (90 + 150)/2 = 120 deg. F. The exchanger contains 270 tubes arranged in two passes, the tubes being ¾ in. O. D., and 0.584 in. I. D. Take viscosity of acetic acid at 0.85 centipoises at 120 deg. F., specific heat c at 0.51 Btu./(lb., deg. F.), and thermal conductivity k at 0.098 Btu./(hr., ft., deg. F.).

Solution—Since there are 270/2 = 135 tubes in each pass, the flow rate per tube F = 168,000/135 = 1,250 lb./(hr., tube). Viscosity μ = (0.85) (2.42) = 2.06 lb./(ft., hr.). The value k/D = (0.098 × 12)/0.584 = 2.01 Btu./(hr., sq. ft., deg. F.) and the Prandtl number $Pr = c\mu/k$ = (0.51 × 2.06)/0.098 = 10.7. (Note that Prandtl numbers for liquids and gases are available in the

appendix of McAdams' "Heat Transmission." The line coordinate charts of Chilton *et al* give *Pr* values at various temperatures for 40 liquids. For gases they are reported at 212 deg. F., with the recommendation that temperature and pressure effects be neglected.[3])

Knowing the flow rate per tube, enter the chart at 1,250 lb./(hr., tube) and connect through $d = 0.584$ in. to the (DG) scale. Extend a horizontal line to $\mu = 2.06$, then project vertically to the j_H scale, choosing the proper scale via the L/D ratio if necessary. Project the line horizontally to $Pr = 10.7$, then vertically to the Nu scale. Continue from the value of Nu through $k/D = 2.01$ to the value of $h_i = 250$ Btu./(hr., sq. ft., deg. F.), which is the desired result.

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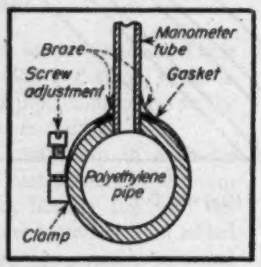
1. Sieder, E. N., and G. E. Tate, *Ind. Eng. Chem.*, **28**, 1429-36 (1936).
2. McAdams, W. H., "Heat Transmission," 2nd Ed., McGraw-Hill Book Co., Inc., New York, 1942.
3. Kern, D. Q., "Process Heat Transfer," McGraw-Hill Book Co., Inc., New York, 1950.

How to Make a Reliable Pressure Tap for Polyethylene Pipe

JAMES M. MADIGAN, *Instructor in Chemical Engineering, Fenn College, Cleveland, Ohio.*

We were unable to construct serviceable pressure taps for use on polyethylene pipe by the usual methods. Due to the insoluble nature of polyethylene, no solvent-cement type of joint was possible and every attempt to make a heat-flow joint failed by deformation of the plastic pipe, even when the manometer tubing itself was also made of polyethylene plastic.



We found the following simple device to give excellent service for this purpose. The pressure tap is constructed from a short piece of manometer tubing, a gasket, and a stainless steel clamp.

HOW TAP IS SECURED

The stainless steel clamp is of the screw-tightening type, similar to an automobile radiator clamp. Clamps of proper size are available—among other sources—from the Johnson Plastic Corp., Chagrin Falls, Ohio. The clamp was designed for clamping the polyethylene pipe to the various rigid plastic fittings such as standard pipe-thread adapters and connectors for connecting lengths of plastic pipe. This clamp is modified by drilling a hole in the solid part of the clamp with an I.D. which results in a tight fit for the O.D. of the tubing that is used to connect the pressure gage.

Generally, ¼-in. copper tubing is satisfactory for pressure connections.

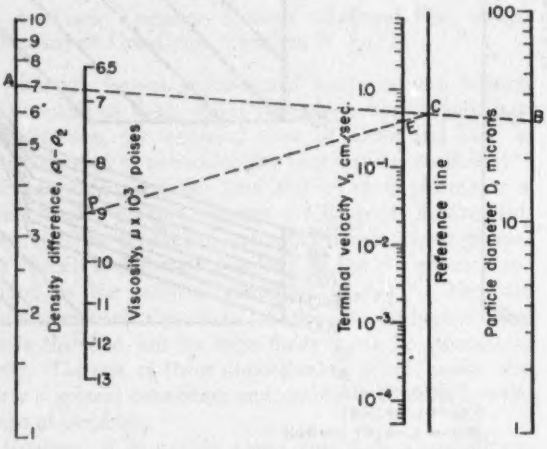
A gasket about ⅛-in. thick and 1½-in. in diameter is cut to fit the pressure tubing. For water service gaskets can be made of standard sheet-rubber gasket material. The copper tubing is worked through the hole in the clamp, a distance slightly greater than the wall thickness of the plastic pipe, plus the thickness of the gasket. Then it is brazed to the clamp on the outside to give a watertight seal.

A hole of the same I.D. as the clamp hole is drilled into the side of the plastic pipe at the tap location, taking precautions to make no burrs or irregularities on the inner surface. (Very neat holes and gaskets can be cut with sharp standard laboratory cork borers.)

The inside end of the manometer tubing is then carefully filed down to give a rounded surface of the same radius as the plastic pipe and a depth which will be flush with the inner surface when the gasket is under compression.

To connect the tap, the curved end of the manometer tubing is inserted in the hole in the plastic pipe, and the screw adjustment on the clamp is taken up to give a snug fit.

If the joint is made properly, very little pressure is required to hold the pressure tap in place without leaking. It should result in reliable measurements.

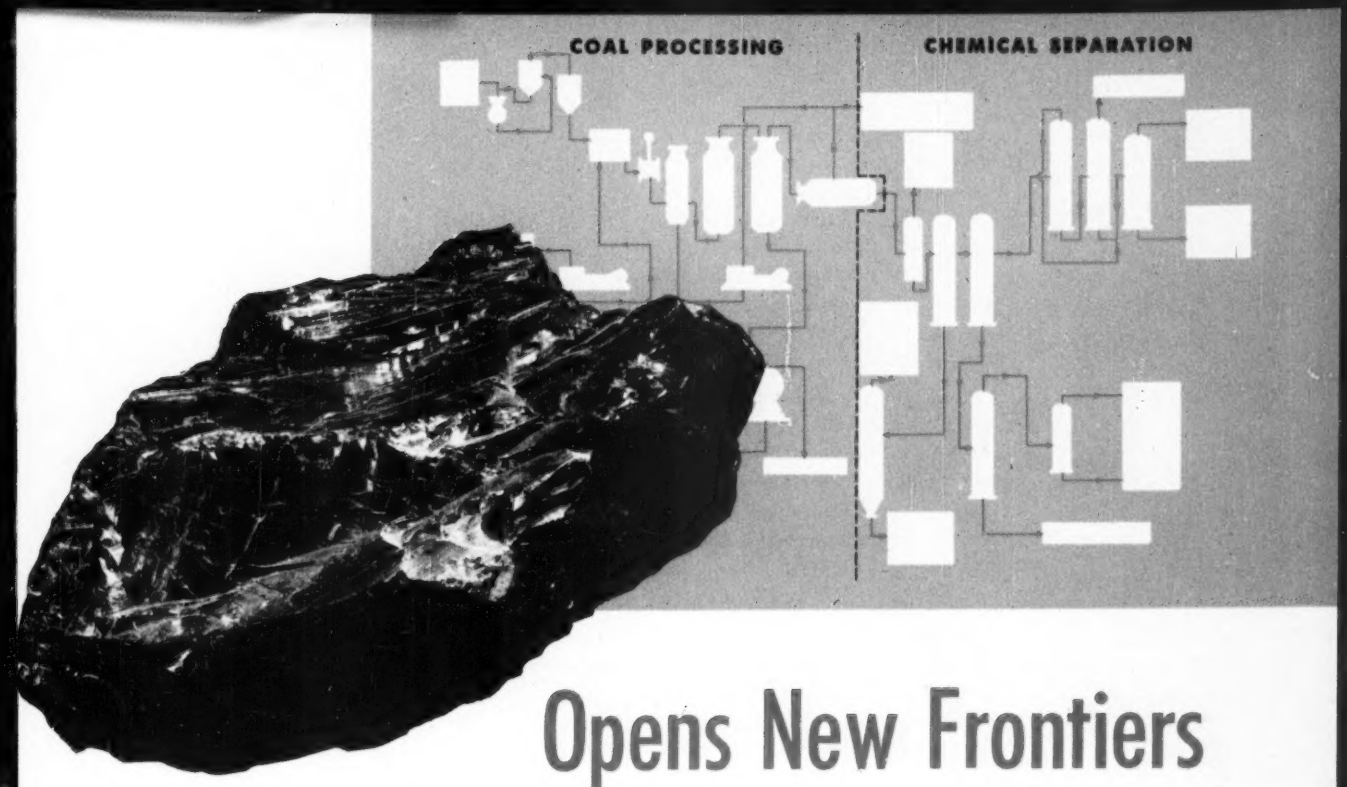


Nomograph Gives Settling Rates For Spherical Particles

G. M. MACHWART and R. J. BAIRD, *Michigan College of Mining and Technology, Houghton, Mich.*

In the mechanics of clarification, when free settling of particles takes place, all particles have free movement and settle at a constant rate. Colloidal particles are an exception to this generalization. This settling follows Stoke's law for settling rates of spherical grains (see Perry, "Chemical Engineers' Handbook," 3rd Ed., p. 937) in which $V = 54.5\ (\rho_1 - \rho_2)\ D^2\ /\mu$, where V = terminal velocity of particle, cm./sec.; ρ_1 = density of particle; ρ_2 = density of fluid; D = diameter of particle in microns; and μ = viscosity of fluid in poises.

This formula may be used to determine either the terminal velocity V or the diameter of the particle D. In using the nomograph, a line is drawn from the difference in the densities, Point A with a value of 7, to B the diameter with a value of 30 microns. From the intersection of this line with the reference line at C a line is drawn to Point P the viscosity, having a value of 9. The intersection of this line with that of V gives a value of 0.39 cm./sec. for the terminal velocity.



Opens New Frontiers

FOR CHEMICALS FROM COAL

AMERICA'S FASTEST-GROWING INDUSTRY — synthetic organic chemicals — has two great divisions. The aliphatics, or straight-chain compounds, are popularly called petrochemicals because so many of them are derived from oil and gas. The older aromatics, or cyclic compounds, have long been known as coal-tar chemicals because their production has been closely linked to that capricious byproduct of the coke oven. Today, thanks to new technology, both of these traditional barriers have been pushed aside to open up new frontiers of progress for chemical industry.

Exactly twenty years ago our first Chemical Engineering Award honored a newcomer that had pioneered in the commercial production of synthetic aliphatic chemicals from the hydrocarbons of petroleum and natural gas. Significantly, the twelfth of these unique awards will be presented this month to the same pioneering company for equally portentous advances in the direct production of aromatic chemicals by coal hydrogenation. What has been accomplished by the Carbide and Carbon Chemicals Co., division of Union Carbide and Carbon Corp., in the two decades between the 1933 and 1953 awards is among the proudest records of our profession. What lies ahead is the promise of still greater growth and achievement.

Carbide has plowed more than $20 million and 17 years of hard research into coal hydrogenation as a source of aromatic chemicals. Chemical engineering knowledge of high order contributed to every phase of the project — from laboratory-scale experiments to the design, construction and operation of the giant 300-ton per day "pilot" plant at Institute, W. Va.

To attain successful and continuous operation of the process called for the

development of new theory and its application by untried techniques. Unusual problems had to be solved in the conception and design of specialized high-pressure equipment. New solvent extraction and separation processes had to be perfected. Careful coordination and control were essential for balanced yet flexible operations. Meanwhile market research had to be coordinated with engineering to evaluate optimum size and character of plant operations. And, from beginning to end, the over-all planning and direction called for unusual technical competence on the part of management, as well as broad understanding of the competitive character of the organic chemical industry.

This was the teamwork that underlies the successful achievement of coal hydrogenation through the pioneering of private enterprise. In the opinion of the late Professor White's 1953 committee of senior chemical engineering educators, this achievement most thoroughly typifies the basic purpose for which the Chemical Engineering Award was established—to recognize and honor those corporate groups that through the effective use of chemical engineering have contributed most to the advance of the industry and profession.

It is significant that Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp., is the first organization to be twice honored by the chemical engineering profession. Equally indicative of its resourcefulness is the fact that it also shared prominently in the two group awards for outstanding wartime achievements—the development of the synthetic rubber industry and the successful completion of the atomic bomb project.

The editors and publishers of *Chemical Engineering*, as sponsors for the Award for Chemical Engineering Achievement, are proud to join with the chemical engineering profession in again honoring a most worthy recipient.

SIDNEY D. KIRKPATRICK
Secretary, Committee of Award

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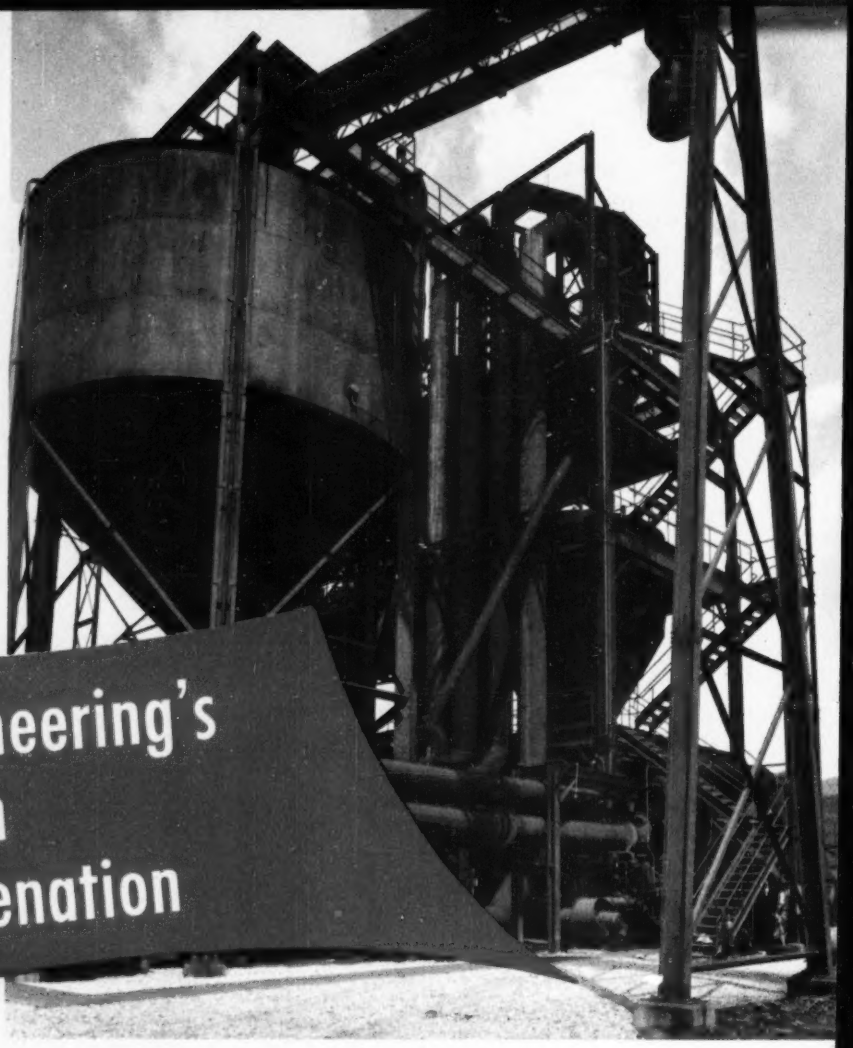


Coal, crushed to the size of wheat grains, is mixed with recycled oil and the paste is pumped to high-pressure hydrogenation unit

Chemical Engineering's Role in Coal Hydrogenation

By Sidney D. Kirkpatrick, Editorial Director of *Chemical Engineering* and *Chemical Week*

IN THE BEGINNING it was just an insurance policy. Back in 1935 many people, especially in government, were talking about a threatened shortage of oil and gas. Dr. George O. Curme, Jr., who was later to become vice president in charge of all research for the Union Carbide and Carbon Corp., was disturbed by these dire prophecies. They seemed to threaten the future of something very dear to his heart – the multimillion dollar investment of Carbide and Carbon Chemicals Co. in the processing of petroleum hydrocarbons to produce synthetic organic chemicals.

So Curme asked his research staff to look into the possibilities of processing coal to obtain these same essential raw materials. What was more logical than to turn to West Virginia's most abundant mineral resource? German technologists were already claiming great things for their newly developed processes for coal hydrogenation. New plants were springing up all over Europe to produce petroleum substitutes from coal – but almost always with the help of governmental subsidies.

What Carbide started as a purely defensive project soon became an aggressive and challenging attack on a new field for private enterprise. From a modest investment of a few thousand dollars in 1935, the total research expenditures had climbed into the millions by 1946. And this was only the beginning, for Carbide researchers had tapped a far richer field than synthetic fuels production. They saw the possibility of almost limitless production of the basic aromatic chemicals. Previously the output of these chemicals had been limited because their production was tied to the operations of the byproduct coke ovens. Once Carbide engineers had mastered the precise control of the intricate variables of the high-pressure hydrogenation process, they were sure that coal could yield a diversity of organic chemicals of better quality and in greater quantity than had ever been obtained by the more destructive, high-temperature carbonization processes.

Meanwhile market research had turned up ample evidence to warrant a much larger supply of aromatic chemicals. New end uses were

increasing the demand by as much as 25 to 35 percent per year. Yet the trend toward greater byproduct production from the coke ovens was up but 3 to 5 percent per year even when plans for the expansion of the steel industries were included. One must have a short memory indeed not to recall how the recurrent shortages of chemical raw materials had so often handicapped the makers of surface coatings, phenolic resins and plastics, disinfectants, dyes and textile chemicals.

Chemicals produced by coal hydrogenation are worth five times as much as synthetic fuels made by the same process. Moreover, it takes less hydrogen to produce them—and that is the crucial cost in most hydrogenation processes. Higher value of the products makes profitable operation possible on a much smaller scale than would be required for synthetic liquid fuel production even though added equipment is needed to separate and refine the hundreds of chemical products.

Basic chemistry of coal hydrogenation is comparatively simple. But putting it to work in a plant is something else again. Even in the early stages of research and development, this tough job called for chemical engineering of high order. During this process of development little, if any, process information was available from abroad. In many ways this was a blessing. It meant that Carbide's chemical engineers had to start from basic experiments, develop their own theories and use their own inherent ingenuity to work out practical methods and equipment. In answer to this challenge they were to develop a process far superior to any other coal-hydrogenation operation for the production of aromatic chemicals.

In 1946 the crucial decision to go ahead with a large-scale pilot plant was again sparked by Dr. Curme. This time he had behind him the results of a decade of successful research and development. He also had the enthusiastic support of his colleagues. Two in particular should be mentioned here: Dr. J. G. Davidson, president of Carbide and Carbon Chemicals Co., had long been his stalwart partner in building that great pioneering industry. Dr. George T. Felbeck, mechanical engineer turned Ph.D. physical chemist, had led the Carbide team in the design, construction and operation of the great gaseous diffusion plant of the atomic bomb project at Oak Ridge. With Paul L. Alspaugh, who had made such a success as a top operating engineer in the synthetic rubber program, Felbeck helped set up a new Physical Processes Department charged, among other things, with putting coal hydrogenation on a practical, continuous and ultimately profitable basis.

Six years and $11 million later, the 300-ton per day pilot plant went into commercial operation during the spring of 1952. Its many unique and outstanding features have been described in illuminating detail by my colleague, John R. Callaham, in *Chemical Engineering* for June 1952, pp. 152-8. It can easily be expanded to handle over 500 tons and far-seeing Carbide engineers even envision a multi-unit plant in the future that might process as much as 3,000 tons of coal in a single day.

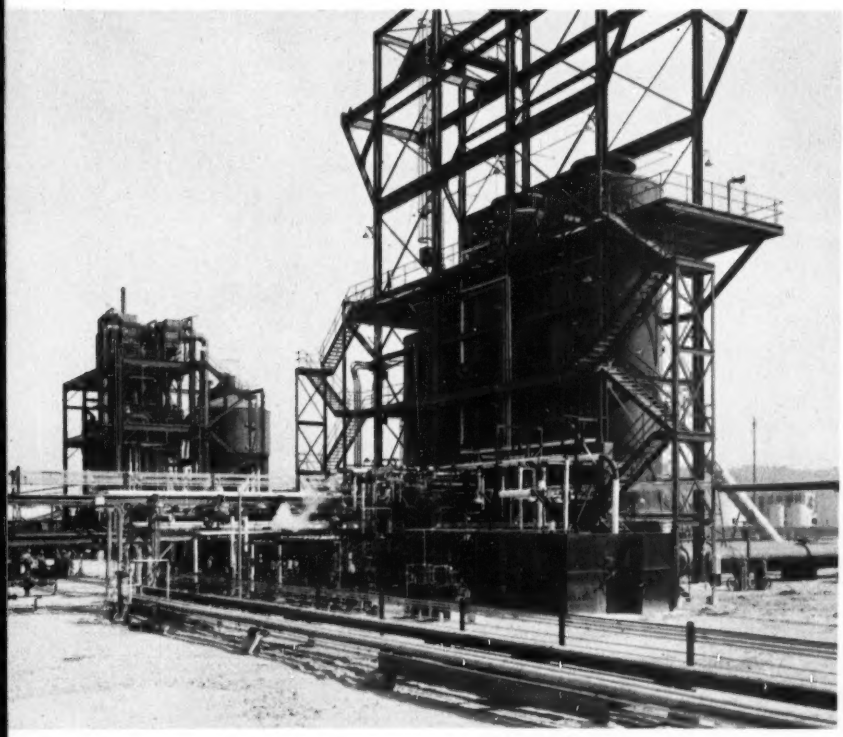
The illustrations on these pages and this month's pictured flowsheet will recall the scale of operations and the over-all arrangement of the units for crushing the coal, mixing it with the carrier oil recycled from the process, catalytically reacting the paste with hydrogen in specially

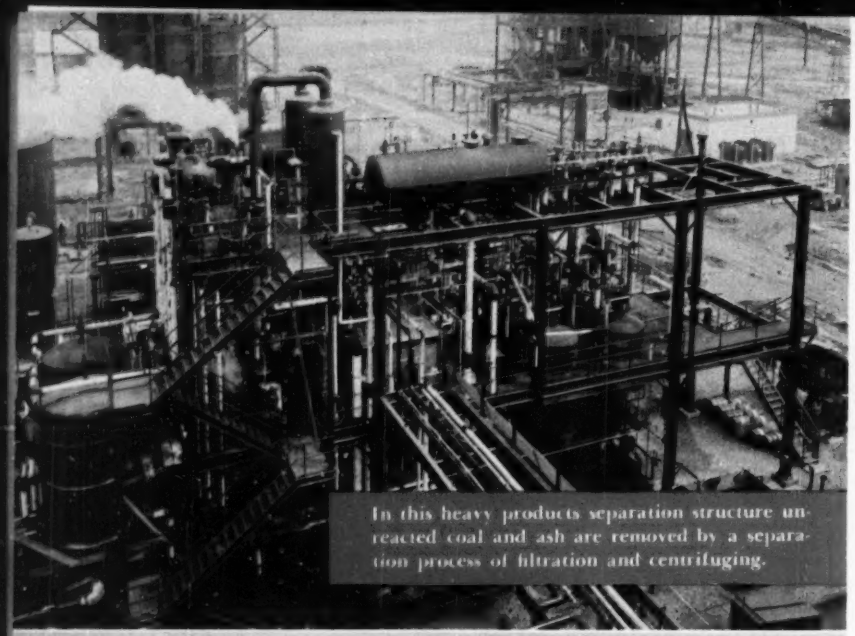
Past and Predicted Requirements for Aromatic Chemicals from Coal

Product (millions of pounds per year)	1950	1955	1975
Phenol	331	600	2,806
Styrene	540	1,000	3,935
Cresols and cresylic acid	90	135	448
Benzene	1,370	(2,260 to 2,340)	(7,000 to 8,400)
Naphthalene, crude	455	700	3,320
Acetylene (chemical uses only)	300	550	3,000
Ammonia	3,502	6,470	13,420
Totals	**6,588**	**11,755**	**34,029**

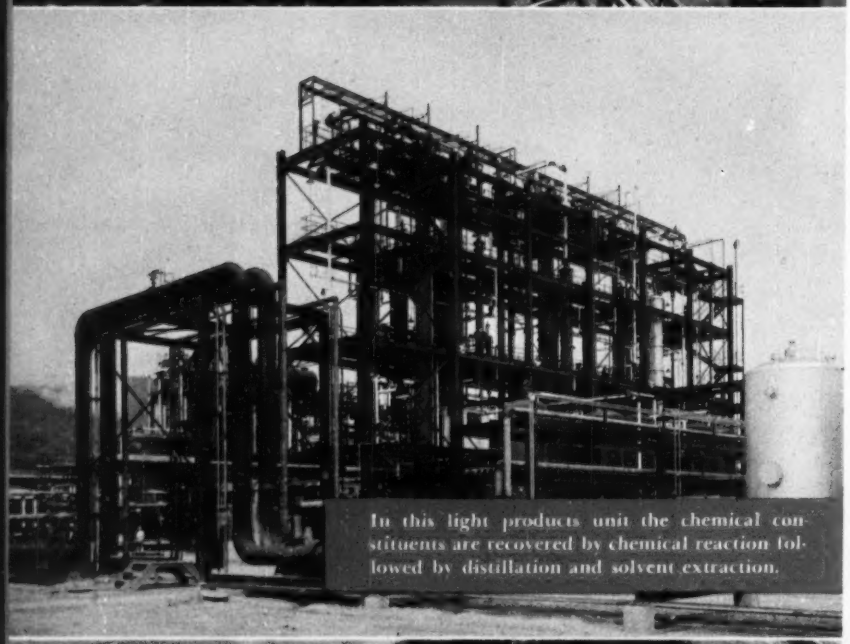
From the Report of the President's Materials Policy Commission, Vol. IV, "The Promise of Technology," June 1952.

Here the coal paste reacts catalytically with hydrogen and is liquefied under pressures up to 6000 lb. per sq. in. and at temperatures approaching 1000 deg. F.





In this heavy products separation structure unreacted coal and ash are removed by a separation process of filtration and centrifuging.



In this light products unit the chemical constituents are recovered by chemical reaction followed by distillation and solvent extraction.

Aerial view of Carbide and Carbon's Coal Hydrogenation Chemicals plant at Institute, W. Va., designed to process 300 tons of coal per day.

designed high-pressure reactors and ultimately separating and storing the various chemical products. The latter, with the time schedule of their commercial production, is given in the accompanying table.

A Ten-Point Success for Chemical Engineers

In the development of the Carbide process, chemical engineers as well as other engineers who have become skilled in chemical engineering, participated actively in all stages of the program:

- Research on a laboratory-scale operation over a period of at least 10 years (1935-45).
- Simultaneous development-scale studies of (a) coal liquefaction, (b) regenerative solvent extraction of the crude liquid product and (c) specialized distillation processes.
- Development of flexible small-scale equipment especially designed for scaling up (300-fold!) to the larger semi-commercial units.
- Economic analysis of the process and development of the optimum method of operation.
- Management decisions on cost, timing, policy and scale of development.
- Process design, including new equipment and techniques for the 300-ton plant.
- Detailed full-scale equipment design in cooperation with fabricators to perfect the special features of the process.
- Operation, maintenance, testing and equipment alterations for the 300-ton unit.
- Engineering analysis of operating and test data.
- Sales analysis and market development for both commercially available and entirely new chemical products for industry.

From the standpoint of the unit operations of chemical engineering, the successful development of the Carbide process involved novel application of basic principles in the following categories: (1) fluid flow, (2) heat transfer, (3) extraction and separation processes, (4) reaction kinetics and (5) materials of construction for exceptionally severe service.

Analyzing the market potentials and developing the sale of the chemicals now being produced has been a continuing job for another group of Carbide chemical engineers. To coordinate this market research with process engineering and plant operations has been a major responsibility of management. It has been possible only because of teamwork toward a single major objective: to provide the chemical industry with a dependable, low-cost source of aromatic chemicals comparable to the present readily expandable supply and great variety of synthetic aliphatic chemicals.

How the Unusual Became Commonplace

Throughout the entire project, the over-riding requirement was for original designs, new techniques and unusual applications of fundamental engineering principles. Here are examples of the problems faced and solved in designing key equipment to operate at 6,000 psi. and up to 1,000 deg. F.

1. Economical production of chemicals by coal hydrogenation required vastly different designs than are commonly encountered in ammonia, methanol and other high-pressure syntheses. Departing from the usual hollow cylinders of most high-pressure equipment, it was necessary to develop special interior designs for the reactors to meet the peculiar conditions required to minimize the destruction of chemical values in the raw product. The forged steel reactor, 35 ft. high and 30 in. inside diameter, is truly the heart of the process. Its walls are 7½ in. thick. Its large forged stainless steel head contains as many as five major process ports in addition to various instrument openings.

2. To meet the requirements of a flexible combination of commercial production and further large-scale development, the equipment had to be designed for rapid and easy dismantling and for ready access to make process changes and improvements. For similar reasons, the entire operation had to provide for rapid shutdown and start-up after reorienting process conditions.

3. Newly designed, gasketed high-pressure piping joints and special

Past and Predicted Major Uses for Principal Coal Chemicals

Chemical and major uses (million lb.)	1950	1955	1975
Phenol in —			
Phenolic resins	195	400	1,950
Chemicals	70	148	780
Solvent refining	15	18	30
Export	14	14	14
Miscellaneous	17	20	32
Totals for phenol	**311**	**600**	**2,806**
Styrene in —			
Styrene resins	355	620	2,135
GR-S rubber	175	380	1,800
Totals for styrene	**540**	**1,000**	**3,935**
Crude Naphthalene in —			
Phthalic anhydride	335	550	3,060
Refined naphthalene	120	150	260
Totals for naphthalene	**455**	**700**	**3,320**
Refined Naphthalene in —			
Dyes and intermediates	64	80	150
Moth repellants	19	24	30
Surface active agents	6	8	10
Leather manufacturing	6	8	10
Miscellaneous	5	8	10
Totals for refined naphthalene	**100**	**128**	**216**
Phthalic Anhydride in —			
Alkyd resins	120	200	1,200
Phthalate esters	83	138	830
Dyestuffs	15	25	65
Food and drugs	7	12	32
Miscellaneous	15	25	65
Totals for phthalic anhydride	**240**	**400**	**2,192**
Cresols in —			
Phenolic resins	34	68	340
Plasticizer (tricresyl phosphate)	36	17	21
Ore flotation	10	12	20
Disinfectants	8	9	13
Engine cleaning compounds	6	7	11
Lubricating oil refining	6	8	16
Lube. oil additives	5	7	15
Textile processing	2	3	7
Miscellaneous chemicals, dyes, and medicinals	3	4	5
Totals for cresols and cresylic acid	**90**	**155**	**448**
Benzene in (million gal.)[1] —			
Phenol	41	82	385
Styrene	65	107	476
Aniline	14	18	27
Nylon	20	30	30
DDT	5	7	50
Diphenyls	3	5	10
Maleic anhydride	3	5	30
Synthetic detergents	10	25	50
Dichlorobenzenes	5	7	10
Monochlorobenzene[2]	5	7	10
Nitrobenzene[3]	4	6	9
Miscellaneous chemicals and solvents	12	20	62
Totals for benzene	**187**	**319**	**1,149**

[1]No account taken of requirements for benzene in fuel for military aircraft.

[2]Other than DDT, phenol and aniline.

[3]Other than aniline.

From the Report of the President's Materials Policy Commission, Vol. IV, June 1952.

piping layouts helped provide trouble-free operation of a tight system under the complete range of process temperatures and pressures.

4. Specially fabricated, compact removable insulating units were developed to protect the high-pressure forgings from high internal reaction temperatures.

5. Newly developed welding and testing techniques considerably extended the flexibility of large-scale design and construction.

6. Specialized equipment for the drying and handling of pulverized coal in circulating hot gas streams has been built and successfully operated to eliminate or minimize thermal decomposition.

7. Handling of dilute and concentrated slurries through pumps, in-process storage, and other equipment has been achieved at temperatures ranging from those at which the material will barely flow up to full operating conditions.

8. Commercially practical methods have been developed for reducing the ash and solids content of the process streams from 25 percent to less than 0.1 percent – thus overcoming the abrasion that has plagued other coal-hydrogenation processes.

9. A completely new system for continuous regenerative separation of the principal chemical product streams into phenolic, nitrogen-base and hydrocarbon fractions has been developed. Completeness of solvent recovery and regeneration results in a negligible net consumption of chemicals. Yet the degree of separation compares with present practice in much simpler operations.

Carbide's Schedule for Aromatic Chemicals by Coal Hydrogenation

These are here now:

High boiling phenols, (chiefly monohydric, alkyl substituted phenols)
Meta-phenols 220, (an ethyl phenol-xylenol mixture)

These are being produced for company's own use.

Benzene	Cresols
Naphthalene	Aniline
Phenol	

These will be available shortly:

Mixed indanols	Alkyl pyridines
Mixed toluidines	Quinoline
Mixed xylidines	Phenol-ortho cresol-blends

These will probably be available after further study on abundance and means of separation:

Toluene	Indanol-5
Xylenes	3-methyl 5-ethyl phenol
Indole	Toluidines (separated isomers)
Indanol-4	

A number of other chemicals are found in the products. Some of those that occur in economically recoverable quantities may be offered for sale. Here are a few of the ones that have been identified:

Indane	2-Methylquinoline (quinaldine)
Acenaphthene	Carbazole
Fluorene	2-Methyl-6-ethylpyridine
Anthracene	3-Methylindole (skatole)
Phenanthrene	n-Propyl phenol
Dibenzofurane	Beta-naphthol
3-Phenylphenol	

More Aromatics for Less Money

How then can we sum up the contributions of Carbide's chemical engineers in transforming the uneconomical German process for fuel production into a profitable venture for the production of aromatic chemicals? Here's what has been done: (1) The time required for the hydrogenation step has been cut from 45 min. in the German process to 4½ min., with the eventual hope of bringing it down to only one minute. (2) Instead of producing a cheap synthetic fuel, the process has been transformed to yield a group of valuable chemical raw materials. (3) The hydrogen requirement has been slashed far below that of a comparable plant for synthetic fuels. (4) Investment has been appreciably reduced. (5) The methods used for refining the product have been simplified and put on a continuous, largely instrument-controlled, basis.

Major gains for the chemical process industries are in the volume and variety of products. Economical production of certain well-known chemicals can now be increased many fold. Carbide can now produce, for example, five to eight times as much naphthalene as can be obtained from an average ton of coal in byproduct coking; 60 to 80 times as much phenol; 100 to 200 times as much of the higher phenols such as cresol, and 300 to 500 times as much of the nitrogen-containing higher amines, such as quinoline. It will produce aniline in infinitely greater amounts since there is now no commercial isolation of this useful chemical directly from coke-oven byproducts. And, in addition, the new process will ultimately introduce a host of new aromatics such as the indanols, methyl naphthalenes and phenols and other higher homologs. If necessary, coal hydrogenation could also produce the aliphatic chemicals and liquid fuels now made predominantly from petroleum and natural gas.

Teamwork Really Meant Achievement

All this adds up to the 1953 award-winning achievement of Carbide's chemical engineers. They participated throughout this whole development – from research and design engineering through construction and plant operation to market research and top management decisions. Carbide and Carbon Chemicals, which is now one of the largest single divisions in the Union Carbide and Carbon Corp., has more than a thousand technical employees of whom about half are graduate chemical engineers. Coal hydrogenation, in large measure, is the achievement of their teamwork. And that, in turn, is Carbide's best insurance policy for the future. As Dr. Curme puts it: "This teamwork [of scientific investigators, engineers, finance, sales and production executives] makes possible not only the practical application of a single discovery, but guarantees an unlimited succession of discoveries over the years."

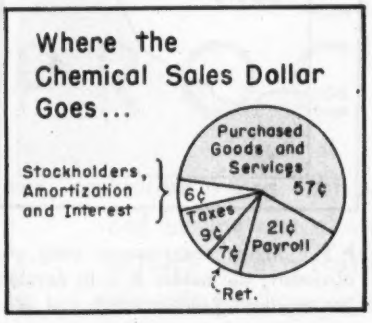
What to Do With That Old Plant?

Maybe it's on the borderline of making or losing money. Should you shut it down or continue to operate? Should you replace it with a modern plant or a new process? Here are some factors to consider.

ROGER WILLIAMS, JR.

Much has been said and written about the close attention which management gives to the estimated investment in a proposed new plant. This attention is well deserved. The best way to save money is simply to spend less. Once the plant is built the money spent to build it is pretty much beyond recall.

What role, then, does investment play in the economics of a going plant?



►**Of the average chemical sales dollar, only 6c. goes to service the operating investment.** This is the sum of interest and amortization on loans plus dividends paid to stockholders.

The other 94c. is distributed as follows: Purchased goods and services, 57c.; payroll, 21c.; taxes, 9c.; and retained money, 7c. That's why you find vice presidents in charge of operations spending so much time worrying about purchasing and labor relations and so little time on the amount of investment they are using.

BORDERLINE CASE

There is one case where investment becomes important in the operating plant. That is when a plant is on the borderline of making or losing money. Then management has to decide whether to keep the plant going or shut it down. How does management go about making the right decision?

Let's consider the simplest case, where the plant involved is isolated from other production units.

We first look at the cost sheets for the product made in that plant and find, let's say, that the product costs $1 per unit but is selling at only 80c., obviously a loss of 20c. on each unit sold. That would certainly indicate that the plant ought to be shut down.

Trouble is, the dollar shown on the cost sheet isn't the true cost of the product. The true cost is the difference between what the company spends with the plant running and what it would spend with it shut down. This is the incremental or out-of-pocket cost.

What costs keep going after the plant is shut down? Purchases will drop to practically nothing. There will be a little maintenance—unless the plant is junked—so some grease and paint will be bought. Some labor will continue, for maintenance and protection. There will be some electric light and possibly some heat in the winter. Unless the plant is junked, the insurance premiums on the plant will still have to be paid.

On the operating cost sheet of the plant there were certain other items, called by various names, covering management expense, sales expense, research, etc. These over-all company expenses were allocated to this particular plant in some way.

OVERHEAD GOES ON

Much of this sort of expense will continue whether or not this particular plant is shut down. For example, unless the plant represents essentially the entire company, the vice president in charge of sales isn't going to have his salary cut; neither will the research budget be pared by the amount which was being charged to this plant. So these costs that go on after shutting the plant down have to be estimated.

Let's assume for our hypothetical plant that these costs amount to 20c. per production unit. Our cost sheet showed $1 per unit so the difference, 80c., is the real cost of keeping the plant running.

There is one more thing, however, that must be deducted. Our original cost sheet included a figure for depreciation in the amount of 10c. per unit. Since depreciation is a sort of tax-free profit item, our real cost is now down to 70c.

The net result of this calculation is that we are selling for 80c. a unit which costs us 70c., a profit of 10c. before taxes and depreciation. The question then is whether or not that 10c. is sufficient profit on the investment we are using.

OPERATING INVESTMENT

What investment are we actually using? First, we are using the plant itself. We can't very well assign the original cost of the plant to the current operation, because the plant has been paid for and we can't get that money back. So we assign merely the scrap value of the plant, less the cost of tearing it down. In general the cost of tearing down a plant is about equal to its scrap value, so we assign an investment figure of zero.

Often, however, we have service facilities like boiler houses, electrical distribution lines, etc., which might be useful in the production of something else. We should include them at their original cost or their replacement cost, depending on the circumstances.

Then, of course, we are using working capital which is recoverable if we shut down the plant. This consists of cash in the bank, accounts receivable, inventories, etc.

Our net result is an investment figure which is the amount of cash we could recover and the usable facilities we would have available if we shut the operation down. This, then, is the real investment we are using.

ROGER WILLIAMS, *a former editor of* Chemical Engineering, *now heads his own consulting firm in New York.*

Now we must examine the profit, before taxes and depreciation, in the light of the investment we are using. We know we could take that money, put it into government bonds, and get a return of at least 2½ percent before taxes. We could probably buy a good common stock, with very little risk, and get about 5 percent. So we ought to show we are getting something better than 5 percent on operating this marginal plant, particularly if our calculations assume that the plant operates at full capacity. Unfortunately over their full lives most plants don't run at full capacity.

MINIMUM ACCEPTABLE RETURN

Most chemical industry managements feel that an existing plant should show about a 10 percent return at full capacity operation, before taxes and depreciation; otherwise they will strongly consider shutting the plant down. In most cases a 10 percent return will mean about 5 percent coming via depreciation, and hence without taxes, and some 2 to 2½ percent net after taxes from the remainder. Thus the net they can pass on to the stockholders or retain for future expansion is 7 to 7½ percent of the recoverable investment they are using.

Do companies ever continue operating plants which show a loss even under out-of-pocket cost conditions? Yes, they do. The usual reason is that the product is needed to round out a line, when the company feels it cannot sell a profitable item unless it also sells the unprofitable one. If the overall profit is sufficient it may keep a losing plant going for that reason.

Another, more minor, reason is when adverse publicity might ensue. For instance, a certain chemical company is the only producer of a particular dye used in inks. Manufacture of the dye is unprofitable. It so happens, however, that this dye is used by the U. S. Government in printing certain values of paper currency. The company feels that the adverse publicity it might get from shutting the Bureau of Engraving and Printing off from its only supply of this dye is worse than the money it is losing making the dye.

WHEN TO MODERNIZE OR REPLACE

Let's turn now to the twilight area where shutting down old plants and building new plants overlap. Here is where improved processes and new techniques are involved. Perhaps they do not require junking an old plant but merely modernizing it.

Consider the simplest case where a new process has been developed which should be considerably cheaper than the old process used in an existing plant. Should we or should we not shut down the old plant and invest in a new one?

First we derive the out-of-pocket cost of production from the existing plant. Next we develop the forecast cost of production for the proposed new plant. Both these figures exclude depreciation. The difference between these figures is the gross saving (before taxes and depreciation) with which we have to justify the new plant.

Next we take the difference between the depreciation allowed on the existing plant and what we think the Internal Revenue Bureau will allow us on the new plant. The new plant will probably be more expensive on the books than the old one, so the annual dollar depreciation will be higher. Subtracting this depreciation increase from our gross saving gives us a taxable income figure, to which we apply our estimated tax rate.

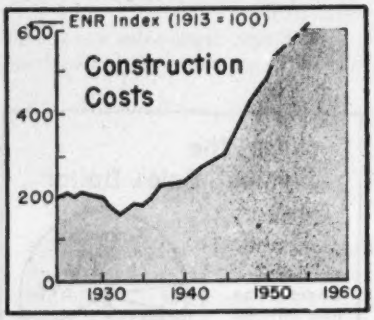
A word is in order here about taxes. Because of the so-called excess profits tax, some companies are paying as much as 70 percent of their pretax earnings to Uncle Sam. Most managements don't expect this to continue forever and hence assume a more realistic arbitrary tax rate in their projected profit calculations. A number of companies are using 50 percent as their forecast income tax rate.

With the net after taxes plus the increased depreciation, we then have the increased company earnings with which we must justify the investment in the new plant. This investment, of course, is the new plant cost plus or minus any estimated change in the working capital required.

The return a given management will require before it will consider putting in a replacement plant varies with the risk. In general, the risk is intermediate between that of a brand-new venture and that of continuing to operate the existing plant. The market may be fairly certain, but often the new process may still be unproved on a plant scale. In any event, managements generally want to see the annual total of net-after-taxes income and depreciation hit 15 percent of the new investment before they will authorize the new plant.

FACTORS RETARDING PROGRESS

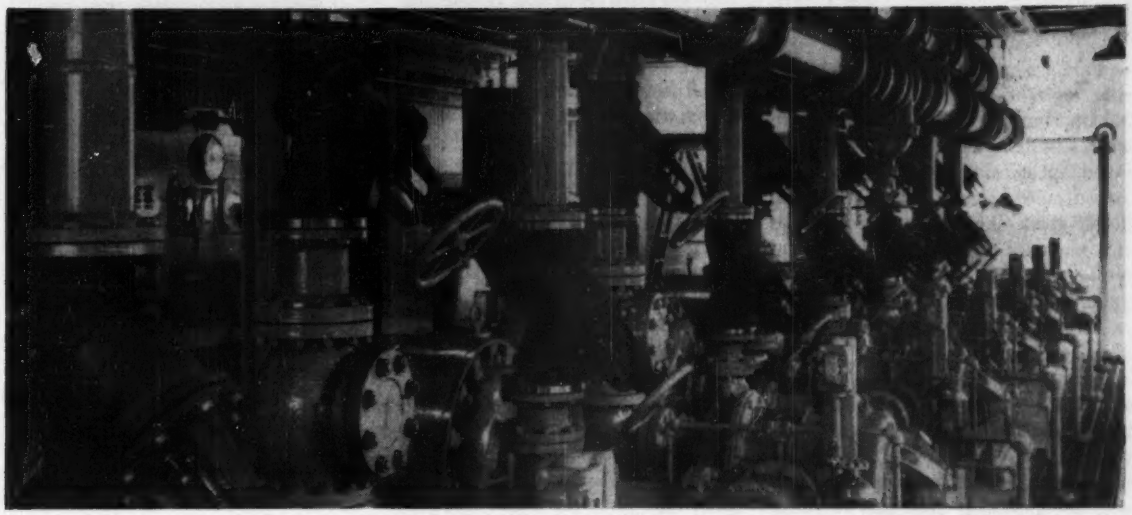
Suppose we are trying to develop a new process to replace a plant built in 1939 when the *Engineering News-Record* construction cost index was 240. Today, construction costs have sailed past an index of 550 and are heading toward 600. We have to develop a process which is so much better that it can lick the out-of-pocket costs of that old plant by enough to pay for an investment for which the construction costs are 2½ times as much! That's no mean task.



► **The higher construction costs go, obviously, the harder it is to develop an improved process which can economically replace an older process.** All too often the new process just cannot show enough savings to justify junking an old but still workable plant.

On top of that high corporation income taxes tend to retard replacement of obsolete plants. After all, if you develop a new process you have to show sufficient savings after taxes to be able to junk the old plant in favor of a new one.

The net result of these two factors, soaring constructin costs and excessively high tax rates, has been to hold back replacement of obsolete plants. All we have to do to see what happens to a nation when it does not maintain its production units on a par with modern technology is to take a look at the British textile industry. They just didn't have any incentive to modernize. Finally other countries came along with more modern equipment and took away the markets. This probably won't happen to the U. S. chemical industry anytime soon, but it is something to think about for the long run.



PROCESS PIPING

Process piping—not only the pipe itself but also the valves, fittings, joints, and all the rest of it—is a subject close to the chemical engineer. It covers so much territory that many books could be written on it. So, with considerable temerity, for those who want a quick picture, we offer here a process piping primer.

THEODORE R. OLIVE*
Senior Associate Editor, Chemical Engineering

CHEMICAL ENGINEERING REPORT—DECEMBER 1953

Fluid handling, along with heat transfer, is doubtless the most widespread unit operation in process plants. By the same token, process piping may well be considered the least common denominator of the chemical process industries. Even those plants which are predominantly processors of solids still use vast quantities of piping, valves and fittings. Lang's study of 14 process plants (*Chem. Eng.*, p. 117, Oct. 1947) showed that piping costs run typically as high as 50 to 70 percent of the cost of the equipment to which the piping is connected, and as high as 15 to 20 percent of total plant cost. And yet, surprisingly enough, the chemical engineering student leaves school for industry with very little knowledge of this class of equipment which may eventually account for a third of his total equipment expenditures.

Our purpose here will be to develop a quick but comprehensive "primer" of the broad field of process piping. Necessarily there will be certain limitations for the subject is encyclopedic. Omitted will be the usual tabulations of data giving dimensions, weights, and so on, for pipe, valves and fittings. These can readily be found in many handbooks and in the catalogs of the manufacturers. Only a brief outline of the approach to piping design can be included. Pipe sizing and the determination of economical size will be honored only by their absence while installation and maintenance can be mentioned only in passing. A major omission will be the selection of suitable materials of construction for process conditions. Instead, it will be assumed that selection has already been made. Taking off from there, we shall then concern ourselves with the more obvious effects of construction materials properties on the characteristics and the design of piping components.

In its organization, this report is broken down into three main sections on: (1) metallic piping components, (2) non-metallic piping components, and (3) codes, standards, design and information sources. Piping, jointing methods and valves will be considered in that order, with the overlying principles, types and designs established in the section on metallic components.

* With deep appreciation the author acknowledges the help of Assistant Editor Raymond F. Fremed who, from his recent experience in the field, has been able to provide many useful suggestions in addition to his authoring of the section on Codes, Standards and Design.

Metallic Piping Components

Pipe used as a general term refers to any type of closed conduit for the transportation of flowing fluids. It includes both rigid and non-rigid types. More specifically, the rigid product is called pipe if its wall thickness is relatively great. Thinner walled conduits are generally called tubing. Non-rigid piping includes metallic and non-metallic hose. Certain of the metallic varieties of hose are also known as flexible metal tubing. Pipe is commonly specified by its nominal inside diameter and its wall thickness expressed as "schedule numbers" or as "standard," "heavy wall," or "extra heavy wall." Tubing, for example heat exchanger tubing, and pipe in larger sizes is usually specified by outside diameter and wall thickness.

Pipe Manufacture—Metallic piping materials are fabricated by several important methods which depend either on the characteristics of the material, or on the use to which the pipe or tubing is to be put. These include: (1) casting, (2) welding, (3) drawing, (4) forging, and (5) extrusion. Casting applies primarily to cast iron, used mainly for large water mains, drainage, and fuel gas distribution; and to metals such as the high-silicon cast irons which cannot be fabricated by other methods. Welding, drawing and forging are used for most of the workable metals and alloys including mild steel and most alloy steels, copper and its alloys, aluminum, nickel and most other metals. Extrusion is applied chiefly to aluminum and lead.

In terms of the quantity of pipe so produced the welding and drawing processes are the most important for process piping. Several welding methods are used when the application of the pipe does not preclude a welded seam. For somewhat more severe service, where pipe without a seam is desired, drawing or forging processes are the ones employed. The welding processes include butt and lap welding by means of dies and rolls, electric-resistance butt welding, hammer welding and fusion welding. The seamless processes include two methods of drawing through dies, and a method of forging from a solid billet.

Most ferrous metal pipe is produced by butt welding in the smaller sizes, or by lap welding in the larger sizes. A strip of metal called "skelp" is heated to welding temperature and forced through dies to form a cylinder and at the same time butt-weld the abutting edges. The method is limited to about 3 in. nominal diameter since the joint so produced is not as reliable as other welding methods. A variation of the butt welding method which gives joints of high reliability for pressure pipe makes use of electric resistance to weld the longitudinal seam. The skelp is forced cold through rolls to form a cylinder, which then passes through a welding machine where heavy current heats the abutting edges to welding temperature by reason of their high resistance. At the same time, rolls force the edges into welding contact. Lap welding, used for sizes up to 12 in., consists in forcing the scarfed skelp at welding temperature through a die to form a cylinder with lapped edges. Then the edges are welded between a mandrel within the pipe, and rolls outside.

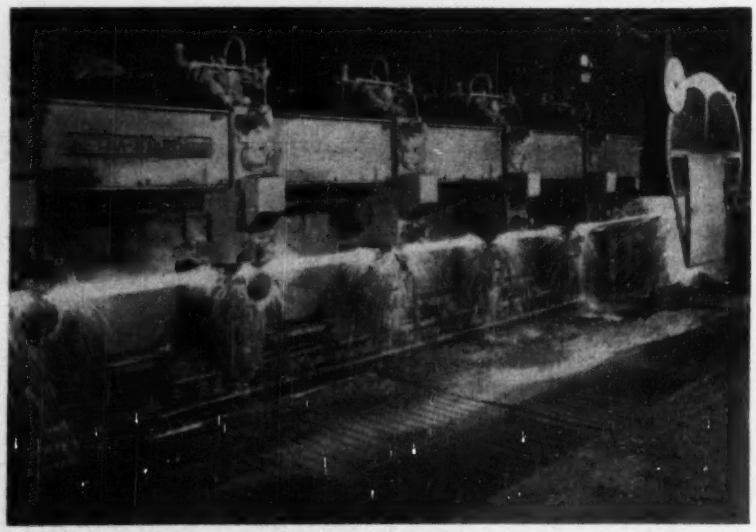
Still larger welded pipe is produced by rolling a plate of proper width and thickness into a cylinder while cold, then heating and forming the weld by hammering the lapped edges against a mandrel; or electric-fusion welding of the abutting edges is the method that is now coming into greater favor for pipe in these sizes.

Another method of forming pipe with a seam is used for lower pressures and mainly in the larger sizes. This gives the spiral type of pipe which involves winding the skelp into a spiral, then forming the seam by riveting—or, more frequently today, by butt or lap welding.

Most seamless pipe is produced by the "piercing" method. The white-hot billet is forced by rolls against a piercing mandrel. While still hot it then passes through a series of reducing, sizing and finishing rolls. For larger sizes the cupping process similarly produces a seamless product. Here a disk of metal is heated, formed into a shallow cup, and the cup is drawn through a series of dies until the desired size is attained. Forged seamless pipe is produced when the heaviest-walled, highest-pressure pipe is required. In this process a billet is drilled, then forged against a mandrel until the desired dimensions are reached.

SIZES OF FERROUS PIPE

Formerly wrought iron and steel pipe were produced in three series of weights for each size, known as standard, extra heavy (or strong), and double extra heavy (or strong). More recently, through work of the American Society of Mechanical Engineers, the American Standards Assn. promulgated ASA Standard B36.10 for wrought iron and steel and ASA B36.19 for stainless steels covering pipe sizes designated under the I.P.S. (iron pipe size) and large-pipe O.D. (outside diameter) systems. These systems apply to both welded and seamless products, provided they are known



Forming pipe on Wheeling Steel's 12-stand pipe mill.

THEODORE R. OLIVE, well known associate editor of **Chemical Engineering,** distilled this report from more than 50 lb. of raw material, mellowed with 30 years' engineering and editing experience, and fired with much midnight oil.

Ted's facility for packing the most information into the least space in the most useful forms has long been apparent to CE's readers. His popular chart on instrument elements, of May 1952, is a good example.

No narrow specialist, Ted finds outlet for his broad knowledge and organizing abilities through his professional society, the ASME. He helped launch its Process Industries division and served as divisional secretary for many years. More recently he has been chairman of the Professional Divisions committee and is now incoming chairman of the Board on Technology. This latter group supervises the manifold technical activities of the society.—C.H.C.

as pipe, rather than as tubing. Under this systems pipes from ⅛ to 12 in. are designated by nominal diameters which bear no relation to either inside or outside diameter—although in all but the smallest sizes, the nominal size is fairly close to the inside diameter of Schedule 40 (old term, standard) pipe. Above 12 in., that is for 14 in. pipe through 30 in. pipe, the size designation is according to the actual outside diameter. Whether the pipe is 12 in. and under, and designated by its nominal diameter, or 14 in. and over, and designated by its actual outside diameter, all pipes of a given size have the same outside diameter, regardless of wall thickness.

This fact is important since it enables threading tools and all other equipment used for jointing to be used interchangeably on a given size of pipe, whatever its weight and wall thickness. Hence, outside diameters were not changed by the new ASA standards, but only wall thicknesses and the method for designating them. And not all wall thicknesses were changed.

Schedule Numbers—The new system set up by B36.10 designates wall thicknesses of steel and wrought iron pipe by a series of schedule numbers including 10, 20, 30, 40, 60, 80, 100, 120, 140 and 160. These numbers are equal approximately to the value of 1,000 (P/S), where P is the internal working pressure and S is the allowable fiber stress, both expressed in lb. per sq. in. Thus the wall thickness increases with the schedule number. The old designation of standard weight corresponds exactly to the Sch. 40 wall thickness in pipe sizes up to 10 in. The extra strong wall designation corresponds to Sch. 80 in all sizes to 8 in. and to Sch. 60 in the 10 in. size. The old double extra strong wall designation has no correspondence with the schedule numbering system. However, pipe manufacturers still use the old designations as well as the new schedule system. So, it is still possible to obtain pipe with the double extra strong wall (XXS) in most sizes up to 8 in.

Not all pipe sizes are made regularly in all schedule numbers. The smaller sizes of steel and iron pipe are made only in Sch. 40, 80 and 160, plus the old XXS type. The schedule numbers above 80 are less common on sizes above 12 in. Stainless steel pipe (ASA B36.19) was formerly made in Sch. 10, 40 and 80. However, as a result of the action the Chemical Industry Correlating Committee of ASA, Sch. 5S for extremely light weight stainless was added to B.36.19 about a year ago, now making it possible to use both light weight Sch. 10S as well as extra light weight Sch. 5S stainless in applications where corrosion resistance or anti-contamination are the prime considerations, rather than strength against high pressures. Stainless 5S costs only about one-half as much as Sch. 40 and is strong enough for many process uses.

Owing to the fact that not all weights of pipe for which standards exist are regularly stocked by mills and warehouses, the user finds it necessary to determine availability and sometimes to change to a higher schedule number or thicker wall than his calculations may indicate. The same is true in the case of other than ferrous materials, such as the copper and copper alloy group.

A further exception should be noted regarding wrought iron pipe. Outside diameters are the same as steel pipe, and weights per foot are the same as the corresponding sizes of standard, extra strong and double extra strong steel pipe. However, inside diameters of wrought iron pipe are slightly smaller to compensate for the difference in density.

SIZES OF TUBING

In general, tubing sizes have not been standardized to the same extent as pipe sizes. Tubing is customarily specified by actual outside diameter and wall thickness, the thickness being expressed either on the B.W.G. or Stubbs scale or in decimals or fractions of an inch. Tubing sizes, rather than pipe sizes, are commonly specified for various kinds of heat exchange equipment such as tube stills, tubular heat exchangers and condensers, boilers and superheaters, and evaporators. The term tubing does not, as is sometimes supposed, connote that the material is a seamless product. Much tubing is in fact welded. Tubing manufacturers distinguish between two types of product, one known as pressure tubing, the other as mechanical tubing.

METALLIC PIPING MATERIALS

Although lead pipe has always been a standby of the chemical industry, and pipe of nickel, copper, aluminum and their alloys has numerous important uses, ferrous materials account for a large part of all the piping in process industries. Carbon steel remains the heavy tonnage piping material, but the chrome-nickel and high-chrome alloys have been moving rapidly ahead.

Carbon Steel—Commercial steel pipe is made of a low-carbon steel specified under ASTM specification A53. It is made in "random lengths" averaging 22 ft., and "double random lengths" averaging 44 ft. It commands a premium for specified lengths. It is intended for moderate service and is commonly called "black iron." Specification A120 covers a similar steel when galvanized. For higher temperature service, lap-welded and seamless steel pipe are produced from a low carbon steel containing under 1 percent Mn (ASTM specifi-

cation A106). Line pipe specified by the American Petroleum Institute is of quite similar composition. There are also a number of other ASTM specifications applying to carbon steel pipe, depending on size range or on method of fabrication. Carbon steel pipe sizes range from ⅛ to 12 in., based on nominal inside diameters, and in O.D. sizes from 14 to 30 in.

Alloy Steels—A large number of alloy steels can be secured in the form of piping, some primarily for temperature and creep resistance, some for corrosion or oxidation resistance. Small percentages of molybdenum or molybdenum and chromium are added for temperature and creep resistance. Increasing the percentage of chromium in such steels tends to increase the corrosion resistance. Such steels also contain small percentages of silicon. As a group they are referred to as the ferritic alloys. Many of them are covered by ASTM specification A335. In a somewhat similar range of alloys specified under ASTM A333 the substitution of moderate percentages of nickel for the chromium and molybdenum permits the use of the steel for low-temperature service. Specialists in high-temperature alloy pipe can provide a variety of these materials, some in seamless and some in welded pipe or tubes in most applicable sizes.

Stainless Steels—Austenitic stainless alloys containing 8 percent or more of nickel and 16 percent or more of chromium are produced in many types, most of which can be secured in the form of pipe or tubing. Among the available alloys are AISI types 304, 321, 347, 316, 317, 309 and 310. The first, third and fourth are the types most commonly used, along with the extra-low-carbon versions of types 304 and 316. Stainless steel pipe is regularly made in sizes to 12 in., and stainless tubing up to 40 in. O.D. The lighter schedules 5 and 10 are more commonly used than the heavier schedules 40 and 80. In addition to the austenitic stainlesses, the high-chrome ferritic steel type 430 (16-18 Cr, no Ni) finds considerable piping use for high-temperature oxidation resistance, for example in tube stills and catalytic cracking.

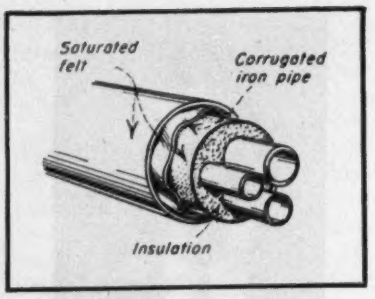
Cast Iron—Cast iron pipe is made by two principal processes, casting in sand molds (pit casting) and centrifugal casting in rotating metal molds. Since the second of these processes gives a denser, stronger product by eliminating blow holes and impurities, it is suitable for higher pressures for a given wall thickness. Cast iron pipe has not yet been fully standardized. The American Water Works Assn. has had standards for water pipe and fittings for many years, as has the American Gas Assn. for gas piping. ASA now has approved standards for centrifugal-cast pipe. Pit-cast pipe made under the AWWA standards is produced in eight pressure classes for hydrostatic heads from 100 to 800 ft., and in nominal inside diameters from 3 to 84 in. The AGA standards apply to centrifugally cast pipe for pressures from 100 to 250 psi. and in sizes from 3 to 24 in. nominal inside diameter. Cast iron pipe is also produced in iron pipe size, with the same O.D. as standard steel pipe in sizes from 1¼ to 12 in., and for pressures of 125 and 250 psi. Cast iron water and gas pipe are made either with plain ends for use with special mechanical couplings which will be described later, or they are provided with cast-on bell-and-spigot ends for caulked joints, or with cast-on flanges for bolted and gasketed joints.

Special Cast Irons—The most commonly used special cast irons for process applications are the high-silicon cast irons. These alloys (for example, Duriron and a somewhat similar molybdenum-containing alloy, Durichlor) are too hard for machining and so must be cast and ground. They are made in inside diameters from 1 to 8 in. using cast-on flanged ends, and from 1¼ to 12 in. with bell-and-spigot ends for use in drainage systems.

NON-FERROUS PIPE AND TUBING

The main constituents of this group include copper and its alloys, nickel and its alloys, aluminum, lead and tantalum.

Copper and Alloys—This group includes materials known as commercial copper, brass, bronze and cupro nickel. In general a brass has zinc as the principal alloying element. Usual red brasses for pipe and tubing have 15 percent zinc. The term bronze generally includes a group of alloys in which zinc is largely or entirely displaced by other metals such as tin, aluminum or silicon, with copper usually making up 90 percent or more of the composition. Cupro nickel or copper nickel covers a range of high-nickel alloys with 10-30 percent nickel.



Pre-insulated piping (Ric-wiL).

From a piping standpoint, copper and various brasses are the principal members of this group. These are produced in both pipe (I.P.S.) and tubing sizes, mostly of seamless construction. Commercial copper and red brass pipe conform in outside diameter to steel pipe, although the inside diameters differ. Sizes range from ⅛ to 12 in. and weights include both standard and extra strong wall pipe. Such pipe may be threaded.

Copper water tubing is produced in three weights and in nominal sizes of ¼ to 12 in. The actual outside diameter is ⅛ in. larger than the nominal size. The three weights are known as Types K, L and M, with K the heaviest. Other methods than threading must be used for jointing such tubing.

Copper and brass Type B tubing have outside diameters equal to those of I.P.S. pipe but wall thicknesses close to that of the intermediate grade of water tubing. Hence, they must be jointed by methods other than threading.

Tubing is also made in outside-diameter sizes with wall thicknesses expressed in decimals of an inch or by the B.W.G. or Stubbs gage system. Sizes range from ⅛ to 12 in. Condenser and heat exchanger tubing is drawn in outside-diameter sizes ranging from ¼ to 2 in., by steps of ⅛ in., and in wall thicknesses expressed by the B.W.G. and Stubbs gage systems. Here tolerances are closer than with the other O.D. tubing.

Aluminum bronze alloys of the Ampco group are made in Sch. 40 and 80 pipe from ¼ to 4 in., Sch. 20 in larger sizes. Condenser tubes come in ⅝ to 4 in. O.D. sizes.

Nickel Alloys—Nickel, Monel and Inconel are produced in both I.P.S. and O.D. tubing types, generally in sizes from about ¼ to about 4 in. They come in a variety of tempers, depending on the type of use. Some of the

other high-nickel alloys such as the Hastelloys can be secured as pipe, generally produced by casting. Hastelloy cast pipes come in ⅛ to 4 in. I.P.S. size, with wall thicknesses closely corresponding to extra strong steel pipe. Some of the Hastelloys are made in thin-walled tubing by rolling and welding.

Aluminum Alloys—Aluminum seamless pipe and tubing are produced in a variety of compositions, including such alloys as 3S, 61S and 63S. Pipe is made to the same dimensions and thicknesses as standard and extra strong iron pipe, in sizes from ⅛ to 12 in. Tubing sizes are rated by O.D. and B.W.G. wall in sizes to about 11 in. Both drawing and extrusion are used in making aluminum tubular products.

Lead and Lead-Lined—Lead pipe is produced by extrusion in several compositions including chemical lead, antimonial lead and tellurium lead. The first is most commonly used, except where the greater mechanical strengths of the alloy materials is needed. Pipe sizes are rated by actual inside diameter, from ¼ to 12 in., and by wall thickness. From four to six wall thicknesses are produced in each size. For applications where the lead needs reinforcement, various weights of lead linings are installed in standard steel pipe, in I.P.S. sizes from ¼ to 12 in. Two lining methods are used. The first, lower-cost method is to expand the extruded lead sleeve into the steel pipe, without bonding. In the second method the lead sleeve is bonded by heat and pressure to the pipe through use of a bonding alloy applied to both the lead sleeve and the pipe interior. The second method is used for more severe service than the first. A third method which also produces a homogeneous bond is to cast the lead in place within the pipe and around a mandrel.

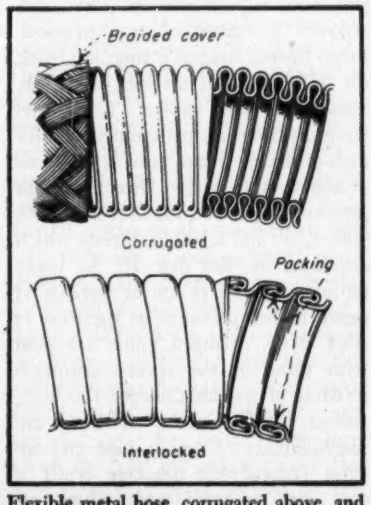
Tantalum—Tantalum may be formed into tubular products by lap or butt welding or by seamless drawing. Such tubes are thin-walled, in a variety of thicknesses, and cannot be threaded. Lap-welded tubing is made in inside diameters from ⅜ in. up, and butt-welded from ½ in. up. Seamless tubing is produced in a range of wall thicknesses in I.D. or O.D. sizes from 1/16 to 2 in.

PRE-INSULATED PIPE

A number of concerns are able to supply pre-insulated pipe for both underground and overhead installation, in both high- and low-temperature insulations. One or more pipes may be installed and insulated in the same conduit. One such concern (RicwiL) produces such units in standard lengths of 21 ft. For underground use the pipe (or pipes) is packed in insulation within a 16-ga. corrugated iron conduit which is then covered with asphalt-saturated felt. Or the conduit may be cast-iron pipe. For overhead use the insulated assembly is wrapped in copper or aluminum foil (min. 0.003 in. thickness) bonded with asphalt and asphalt-impregnated felt. In all such pre-insulated assemblies the pipe ends protrude to allow welding or other methods of joining adjacent lengths of pipe. After joining the lengths the gap is insulated and sealed.

FLEXIBLE METAL HOSE

Terminology is not entirely uniform in this field, but the term flexible metal hose is usually a general one, covering both interlocked and seamless corrugated tubes, while the term flexible metal tubing generally refers only to the latter construction. In the interlocked construction a strip of metal is wound spirally and interlocked on a sizing mandrel, either with or without a packing of impregnated asbestos. Interlocked hose is made in sizes from ½ to 24 in. I.D., for various pressure and non-pressure applications. For applications in which extreme tightness is required the tube is seamless or seam-welded and is deeply corrugated to give flexibility. Sizes in this type range from 3/16 to 6 in. I.D. Where extra strength or protection is required, the corrugated type is provided with a braided wire covering. Flexible metal hose and tubing come in a variety of metals including, steel and galvanized steel, brass, bronze, stainless alloys, aluminum and Monel. Special end couplings which are attached by soldering or by metal-to-metal joints, usually by the manufacturer, are available in the same metals used in the hose, and for standard screwed or flanged connections to equipment. In both hose and tubing any desired length can be supplied.



Flexible metal hose, corrugated above, and interlocked-packed below.

Pipe Jointing Methods

A large number of methods have been developed for joining pipe or tubing to other lengths, or to valves, or equipment. To some extent these depend on the characteristics of the pipe material, while in other cases the choice among several methods may be dictated by operating conditions such as pressure, temperature or corrosion, or convenience, cost or preference.

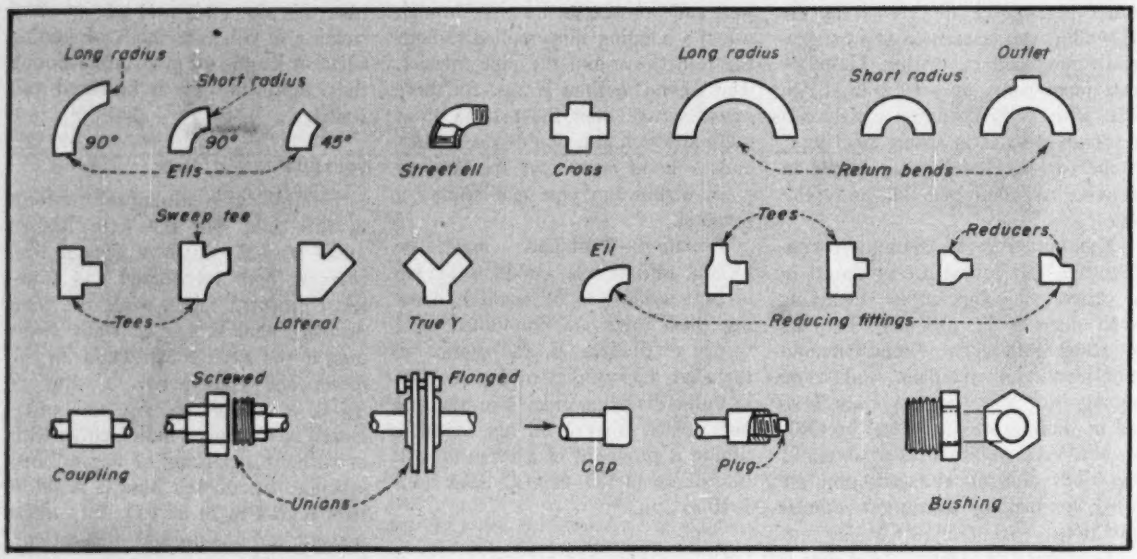
Despite the numerous methods, and the almost staggering number of types and styles of fittings that are encountered, these means of jointing can be grouped into six main classes:

Screwed joints
Flanged joints
Butt- and socket-welded joints
Brazed and soldered joints
Packed or poured joints
Flared and compression joints

Such joints have the following main functions:

Connect pipe to pipe, valves or equipment
Change pipe direction
Change pipe size
Introduce branch lines
Close off a line

These functions have resulted in the development of special fittings for each of the various purposes in all of the various jointing methods. As a general rule, the function of the fitting, rather than the jointing method, determines its name, although there are some variations. The principal names among such fittings are the ells or elbows, which serve to change direction; the tees and laterals (Y-branches) which introduce a branch line at 90 or at 45 deg.; the crosses



Functions of fittings shown diagrammatically; they change direction, introduce branch lines, change pipe size, connect to pipe or equipment, and close off pipe, fittings or equipment.

which introduce two branch lines 180 deg. apart, and at 90 deg. to the flow; the return bends which change the pipe direction 180 deg.; the couplings which join two lengths of pipe, usually without easy means of disassembly; the unions which join two pipe lengths with easy disassembly; the caps which close off a pipe by being attached over its end; the plugs which close off a pipe by being secured within a fitting; the reducing fittings which have one or more of their connections of smaller size than the others; and such special fittings as combination types (e.g., union elbows), or regular fittings with an extra side outlet, such as side-outlet ells and tees.

Some of the jointing methods are combinations of two methods. For example, flanged connections are made between flanges which may be attached to the pipe by a screwed joint, by welding, or by expanding the pipe into the flange, just as a tube is rolled into a heat exchanger tube sheet.

Screwed Joints—Screwed joints are used with I.P.S. pipe. Although most types of screwed fittings are made in fairly large sizes, they are ordinarily not used in sizes over 2 or 3 in. since the difficulty of making a good screwed joint increases with the size. Screwed fitting types are outlined in Table I. They are available in most of the piping metals which can be threaded. Among them are cast and malleable iron, cast and forged carbon steel, several stainless steels, brass and bronze, cast and forged Ampco bronze, nickel, Monel, Inconel, aluminum and lead-lined iron. Some suitable kind of pipe "dope" is customarily used to lubricate and seal pipe threads. This is especially important in the case of certain alloys such as stainless which tends to gall (sieze) on heavy metal-to-metal contact.

Cast iron screwed fittings are made to two standards, 125 and 250 lb. These pressures refer to use at saturated steam temperature. For liquid and gas at not over 150 deg. F. the allowable pressures are respectively 175 and 400 psi. Malleable iron screwed fittings, owing to their lack of brittleness, are rated for higher pressures. The 150 lb. class is good for 300 psi. liquid or gas pressure at 150 deg. F., and the 300 lb. class for 2,000 to 800 psi. liquid or gas pressure at 150 deg. F., depending on diameter.

Forged steel screwed fittings are suitable for much higher pressures. They are made in 2,000, 3,000 and 6,000-lb. classes, rated for cold, non-shock service. At 900 deg. F. steam, oil or vapor temperature the allowable pressures are reduced to 625, 1,000 and 2,000 psi. respectively.

Brass and bronze screwed fittings are made in the same ratings as cast iron.

Special screwed fittings have been standardized by the Compressed Gas Manufacturers' Assn. for use on gas storage cylinders. Different gases use different types of fittings to prevent possibly hazardous cross-connections.

Flanged Joints—Flanged joints, or a combination of flanged joints and welding, are used in most process piping in sizes over 2 or 3 in. Many kinds of fittings, including jacketed cast iron and steel fittings, are available with cast flanges, the principal types being shown in Table I. Cast iron pipe, especially that for gas, is often produced with cast-on flanges. Cast iron flanged fittings are made in the same 125-lb. and 250-lb. standards as cast iron screwed fittings, with the same higher pressure allowances at lower than saturated steam temperatures. Bronze flanged fittings are made for 150-lb. steam service, or 225-lb. non-shock cold service. Cast steel flanged fittings are commonly used for high-pressure steam service and oil at high temperatures. There are seven pressure classes of 150, 300, 400, 600, 900, 1,500 and 2,500-lb. fittings which are rated at 900 deg. F. At lower temperatures these are acceptable at much higher pressures as specified in ASA B16e. Flanged joints are used with some of the special corrosion resisting alloys, for example the high-silicon irons, because of their unmachinability. Duriron pipe and fittings (except the drainage type) is cast with enlarged ends which are held together by means of slip-over

Table I—Main Kinds of Fittings Produced in Various Types

(This list is believed to be reasonably complete, but no claim to absolute accuracy is made.)

Screwed Pipe Fittings*
- Ells, 45 and 90 deg.
- Street ells, 45 and 90 deg.
- Ells, side outlet
- Tees
- Street tees
- Side outlet tees
- Laterals
- Crosses
- Return bends
  - Long radius
  - Short radius
- Couplings
  - Righthand
  - Left and right
- Unions
  - Screwed
  - Flanged
- Nipples
  - Close
  - Short
  - Long
  - Tank
- Caps
- Plugs
- Reducing fittings
  - Ells
  - Tees
  - Crosses
  - Reducing couplings
    - Concentric
    - Eccentric
  - Bushings
    - Concentric
    - Eccentric
- Combination fittings
  - Union ells
  - Union tees

*Some further variations in drainage and other specialized fittings, e.g., sprinkler, ammonia.

Flanged Pipe Fittings
- Ells, 90 deg.
  - Long radius
  - Short radius

Flanged Pipe Fittings (cont.)
- Ells, 45 deg.
- Base ells
- Ells, side outlet
- Tees
- Base tees
- Tees, side outlet
- Laterals
- True Y's
- Crosses
- Return bends
- Flange unions
- Blind flanges
- Reducing fittings
  - Ells
  - Tees
  - Laterals
  - Crosses
  - Reducers
    - Concentric
    - Eccentric
  - Reducing flanges
- Jacketed fittings (heating or cooling jacket)

Flanges
- Screwed
  - Full size
  - Reducing
- Slip-on welding
- Socket welding
- Welding neck
- Lap-joint (Van Stone)
- Serrated bore for rolling in pipe
- Orifice flanges

Flange Facings
- Flat face
- Raised face
- Ring joint
- Tongue and groove
  - Large
  - Small
- Male and female
  - Large
  - Small
- Lap joint (raised)

Butt-Welding Fittings
(Pipe and tubing sizes)
- Ells, 90 deg.
  - Long radius
  - Short radius
- Ells, 45 deg.
- Tees
- Laterals
- True Y's
- Crosses
- Return bends
  - Long radius
  - Short radius
- Weld-backing rings
- Welding neck flanges
- Slip-on flanges
- Lap-joint stubs
- Caps
- Branch-reinforcing saddles
- Shaped nipples (for branches)
- Reducing fittings
  - Ells
  - Tees
  - Crosses
  - Reducers
    - Concentric
    - Eccentric

Socket-Welding Fittings
- Ells, 45 and 90 deg.
- Tees
- Laterals
- Crosses
- Return bends
- Couplings
- Flanged unions
- Caps
- Reducers

Brazing Fittings
- Ells, 45 and 90 deg.
- Street ells
- Ells, side outlet
- Tees
- Single-sweep tees
- Laterals
- Crosses

Brazing Fittings (cont.)
- Return bends
  - Long radius
  - Short radius
- Caps
- Plugs
- Reducing fittings
  - Ells
  - Tees
  - Laterals
  - Crosses
  - Reducing couplings
  - Bushings
- Threaded adapters

Compression, Flare Fittings
- Ells, 45 and 90 deg.
- Tees
- Crosses
- Unions
- Reducers
- Adapters to scr. thds.
- Combination fittings with one or more I.P.S. ends available in all types

Bell-and-Spigot Fittings†
- Ells, 1/4, 1/8, 1/16, 1/32 bend
- Base ells
- Tees
- Base tees
- Laterals
- True Y's
- Offset bends
- Crosses
- Couplings (sleeves)
- Plugs
- Reducing fittings
  - Ells
  - Tees
  - Crosses
  - Reducers
- Packed mechanical joints

†Most types made with either bell ends or spigot ends, or combination of both.

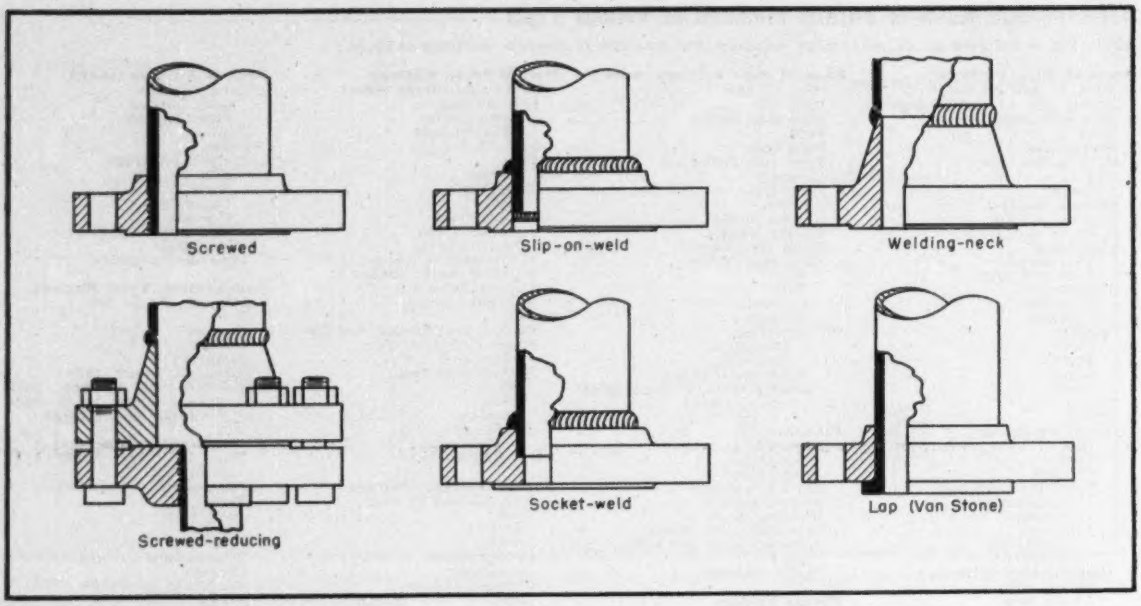
split flanges bearing on the enlargements. Lead fittings, except the welding type, are flanged.

Although there has been a tremendous increase in the use of welded joints in process piping, welded lines generally contain a good many flanged joints for connections to valves and equipment (which are usually not welded for maintenance reasons), and for ease in erection and maintenance of the line. This means that in addition to cast-on flanges on the fittings, there is also an enormous use for separate flanges to be secured to pipe. The main types of flanges are listed in Table I. The simplest method of flange attachment to the pipe is by a screwed joint, but this is not much used except in smaller sizes and at lower pressures. Welding is the commonest method of attachment but here there are several different types of flange. The slip-on flange fits the O. D. of the pipe and is welded to the pipe at both the face and back of the flange. In the smaller sizes the socket-welding flange is often used. This type has a recess extending part way through the flange bore into which the pipe fits snugly. Since the pipe cannot easily be welded at the bottom of the recess, the only joint is at the back of the flange, leaving a crevice at the pipe end, with the possibility of crevice corrosion.

For many purposes the welding-neck flange is preferred to the types mentioned above. This is a flange formed with a short tubular stub extending from the back for welding to the pipe. The last of the common methods of flange attachment is the lap or Van Stone joint. Although this is sometimes made by simply flaring and butting the ends of two lengths of pipe, and holding the turned-up ends together with loose flanges, this method leaves a crevice and is generally not well regarded. Instead, the end of the pipe (or a welding stub) is upset to form a small, thick flange which is then machined to a square corner where it joins the pipe interior. In shop-fabricated pipe this may be done to the pipe itself. More commonly a forged welding stub of proper shape is welded to the pipe end. Again, loose flanges force the abutting laps together. The loose flanges are a decided advantage in lining up.

There is one more method of flange attachment that is finding use with the light-weight stainless pipes, Sch. 5S and 10S, and with stainless tubing. This is to roll the pipe or tube into serrations in the flange by means of an ordinary tube expander. The method is similar to the way in which condenser and heat exchanger tubes are rolled into tube sheets. A variation of this idea is used by at least two manufacturers who specialize in light-weight stainless. This is to roll the pipe into a small stainless insert rather similar to the enlarged end on a lap joint. This permits the use of loose flanges which may then be of carbon steel. The method was first used on sanitary tubing by Tri-Clover Machine Co.

Flange Facings—Although it is possible to produce tight flanged joints without the use of gaskets by grinding the abutting surfaces to an exceptionally fine finish, this method is seldom used because of its difficulty and expense. Instead, gaskets of such materials as rubber, asbestos, fiber, metal, and metal-non-metal combinations are ordinarily used. The American standard for flange facings was set up by ASA in 1939 under Standard B16e which applies to forged steel flanges for the same pressure ratings used for cast steel flanged fittings, namely, 150, 300, 400, 600, 900, 1,500 and 2,500 lb. The standard set up eight facings, all but one of which



Five principal methods are used for attachment of flanges to pipe; note how flanges can be used for reducing.

limit the bearing area to less than the flange area so as to increase the gasket unit pressure for easier sealing. These facings include the flat face (entire flange area); raised face, which is a flat facing of reduced area; the lap joint already noted, which gives a seating surface similar to the raised face; large and small tongue-and-groove and male-and-female joints, all of which confine the gasket at the outside and help prevent its blowing out; and the ring joint. This last is an annular, tapered depression with a flat bottom which is cut into each of the mating flanges and contains a metal ring of oval or octagonal cross section. Rings are commonly of soft iron, soft steel or low-chrome steel. This last type joint is much used for high-pressure, high-temperature process and power work. Cast steel flanged fittings, for example, are often grooved for ring joints.

Welded Joints—Most piping materials are capable of being welded and welding has therefore had a remarkable growth. Formerly the welder was forced to fabricate his own bends and branches, but the advent of extensive lines of welding fittings now makes this unnecessary and greatly facilitates the welding process. In addition to the flanges already discussed, weld fittings are made in two general types, the butt-weld fitting, and the socket-weld fitting. The main variations of each type are listed in Table I. Butt-weld fittings of carbon steel come in all pipe sizes and in thicknesses corresponding to standard, extra strong, Sch. 160 and double extra strong pipe, as well as some special schedule numbers in some cases. In stainless they are made in Sch. 5S, 10S, 40S and 80S, as well as O. D. tubing sizes. They are regularly available in such alloys as stainless 304, 316 and 347, in nickel, Monel, Inconel, Hastelloys B and C, in aluminum 3S-F and in copper, brass and bronze, and Ampco bronze. Their pressure ratings are the same as that of pipe of the same size and schedule number. They are of seamless construction and except in the thinner schedules are scarfed ready for welding.

One of the problems in butt welding is to prevent the formation of "icicles" inside the pipe. Weld-fitting makers all provide tubular inserts or welding rings which help to prevent icicles, align the abutting pipes, and serve as spacers in securing the desired gap between pipes at the root of the weld.

Socket welding fittings come only in the smaller sizes, usually only up to about 4 in. They facilitate welding by aligning the pipe but have the disadvantage already noted of leaving a crevice. They are available in forged carbon, low alloy and stainless steels, as well as nickel and Monel. In forged steel the ratings are for 2,000, 3,000, 4,000 and 6,000 lb. Somewhat similar to socket weld fittings are the recessed-end stainless fittings supplied by Tri-Clover Machine Co. for brazed, soldered or socket-welded joints with light-weight O. D. stainless tubing. Here the sockets are pressed into the wall of the fitting.

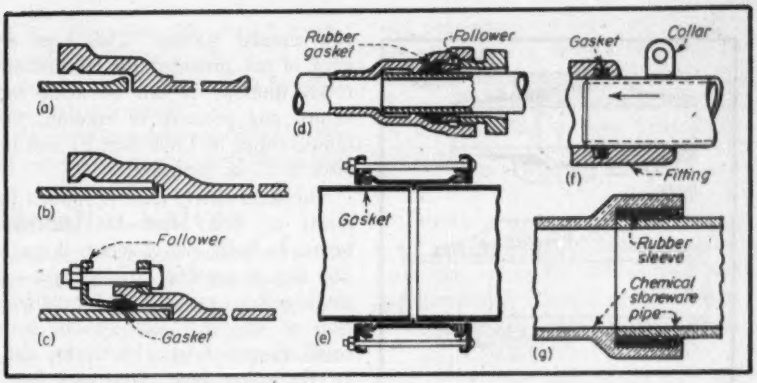
One novel type of weld fitting now made in Sch. 5S stainless is produced by the Horace T. Potts Co. These fittings have exceptionally long tangents which enable flanges to be welded directly on to the fittings and give the advantage of welding always on a straight section.

Brazed and Soldered Joints—Soldering is a method of jointing that is used extensively for brass and copper water and refrigerant piping. More recently, with the development of special brazing fittings designed for using high-strength silver brazing alloys, this method has become suitable for a variety of process uses as well. Both brazed and soldered joints depend on drawing a relatively low-melting solder or brazing alloy by capillarity into the close clearance between the socket in a valve or fitting and the pipe or tube wall, and filling this space completely. This is accomplished through proper application of heat to the fluxed joint. One of the newer developments is a special line of fittings and valves (Walseal) which

have a recess in the socket containing enough brazing alloy to make the joint. Otherwise the solder or alloy must be drawn into the heated joint from outside. Solder-joint fittings are thin-wall wrought copper. Brazed-joint fittings are generally of cast bronze or malleable iron. The brazing method has also been used for ferrous and stainless pipe as well as for copper and brass. Among the advantages claimed are speed and ease of producing the joint, even in inaccessible places. Exceptionally high strengths are claimed.

Packed and Poured Joints—This group includes the bell-and-spigot joints commonly used on cast iron water, gas and sewage pipe, as well as various proprietary joints such as the Dresser and Victaulic which are used mainly on large-diameter steel and cast iron pipe. Some of these joints allow for a small amount of lengthwise expansion, as well as a little angular misalignment.

Bell-and-spigot joints are packed at the bottom with a flexible material such as oakum or asbestos, and are then filled with molten lead, shredded lead tamped in, portland cement, or a sulfur-base pouring compound. Or such pipe may be coupled with a lead packing ring and rubber gasket which is forced against the bell and the pipe by a metal follower, or gland, bolted to the bell. The Doublex-Simplex joint is of this type. Dresser couplings are used on plain-end cast iron and steel pipe and consist of a sleeve with a gasket and stuffing box arrangement at each end, into which the pipes to be coupled are slipped.



Packed and poured methods of joining: (a), (b) Bell-and-spigot joints for sand-cast and centrifugal-cast iron pipe; (c), (d) typical mechanical joints for large and small cast iron pipe; (e) Dresser coupling; (f) Quikupl coupling (Cooper Alloy); (g) Flexlock joint.

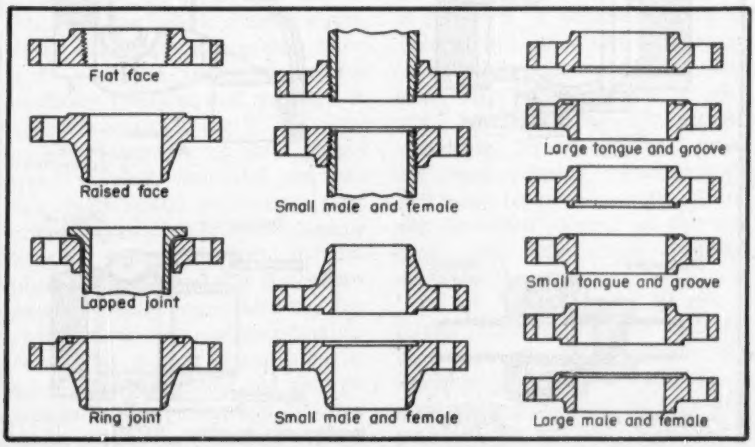
The Victaulic coupling requires the pipe ends to be grooved. A cylindrical gasket placed over the joint between the pipes is forced against the pipes by a split cylindrical housing which fits into the pipe grooves and thus prevents the pipes from pulling apart.

There are also a number of other packed-joint couplings of different types. The Quikupl joint of Cooper Alloy Foundry is used on stainless fittings of iron pipe size. It consists in a tapered neoprene or Butyl rubber seal ring installed in a groove within the fitting socket. The ring is designed to seal more tightly against a pipe pushed into it as the internal pressure increases. The pipe is prevented from pulling out by a bolted collar attached to the fitting.

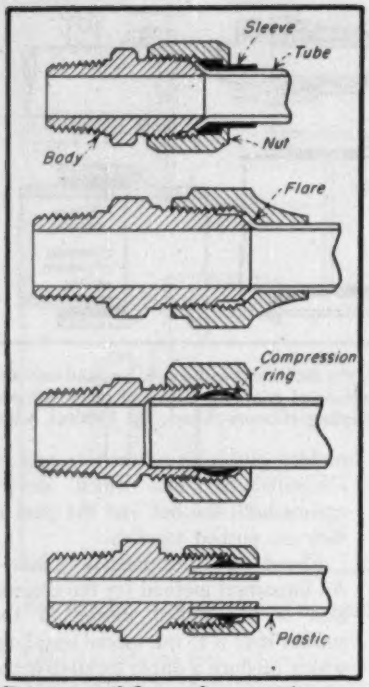
Another type is the Flexlock joint which has been used mainly for non-metallic pipe of suitable bell-and-spigot design. The packing ring is a molded rubber sleeve with a series of circumferential fins which deflect against both the bell and the pipe as they are pushed together.

Flared and Compression Joints—An important method for the connection of thin-walled tubing in the smaller sizes is to use special couplings which produce a direct metal-to-metal seal between the tube and the fitting as a result of the pressure of a nut screwed onto the fitting. Fittings of this type are generally made in O. D. tubing sizes from $\frac{1}{8}$ to 2 in. They are made in such materials as brass, steel, stainless 316, and various aluminum alloys. Although there are quite a number of variations to the basic idea, these boil down in general to two main types: (1) flare fittings, and (2) compression fittings. In the first the end of the tube is initially flared with a special tool. The inside of the flare is then forced securely against the conical tapered end of the fitting by means of a nut which is screwed up against the outside of the flare. In some types the nut contacts the outside of the flare directly, and hence must turn against it. In another type a non-turning sleeve transmits the pressure of the nut to the flare.

The second, or compression coupling, in its simplest form uses a small more or less spherical metal sleeve or ferrule to form the seal. Here the tube need not be flared. The sleeve is pushed onto the tube, the end of the tube is pushed into a socket in the fitting and the nut is screwed onto the fitting to compress the sleeve against both the tube and the fitting. Parker Appliance Co. has developed a variation of the compression type for heavy-wall tubing in which a spe-



Eight American Standard methods of flange facing. (Note two methods for small male-and-female facing).



Four types of flare and compression couplings: Top, Parker flare, separate sleeve; plain flare type; plain compression type; compression coupling for plastic tubing (Imperial Brass Mfg. Co.).

cial cylindrical ferrule is deformed as the nut is screwed up so as to bite into the tube around its entire circumference, securely wedging it into the fitting. Such fittings are made in sizes from ¼ to 1 in. tubing outside diameter.

Compression and flare fittings are widely used for hydraulic and instrument-air lines. Many of the available fittings have pipe threads on one outlet to permit connection to pipe or to pipe-threaded equipment.

SPECIAL JOINTS

All of the joints discussed thus far have had the purpose of making a more or less permanent rigid connection. There are a number of special types of joint in which the purpose is to permit motion between the pipes so connected, between a pipe and equipment, or to allow quick and easy connection and disconnection of pipes.

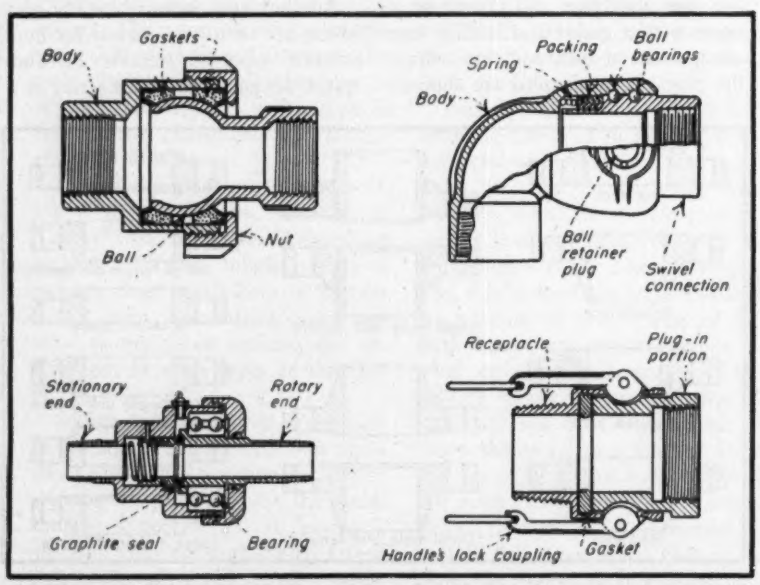
Ball, Swivel and Revolving Joints—Ball joints permit a certain amount of angular motion between pipes, as well as swivel action through 360 deg. The type illustrated uses a fitting with one end ground spherical so as to flex or rotate within a housing packed with two annular gaskets. This type of joint is not intended for continuous rotary motion. It can be made for almost any pressure or vacuum, for temperatures to 1,000 deg. F., and in sizes to 12 in. pipe size.

The term swivel joint is applied to joints of two somewhat different types. In both, swivel action through 360 deg. is possible. In one type—a single-gasket, spring-loaded modification of the ball joint—there is a small amount of lateral flexibility also. In the other type, illustrated here, and sometimes called a swing joint, the swivel action is in a single plane only. Most swing joints are equipped with ball bearings. A novel feature of the design shown is that the pressure between the swing section and the packing is predetermined and self-adjusting by pre-loading of the double row of ball bearings. Such joints are commonly supplied with two or three swivel sections in a single fitting so as to allow motion in any direction. Joints for pressures up to 1,000 psi. are made as large as 12 in. High-pressure joints are designed for as much as 15,000 psi. One of the most important uses for such joints is for pipe lines serving liquid loading and unloading facilities.

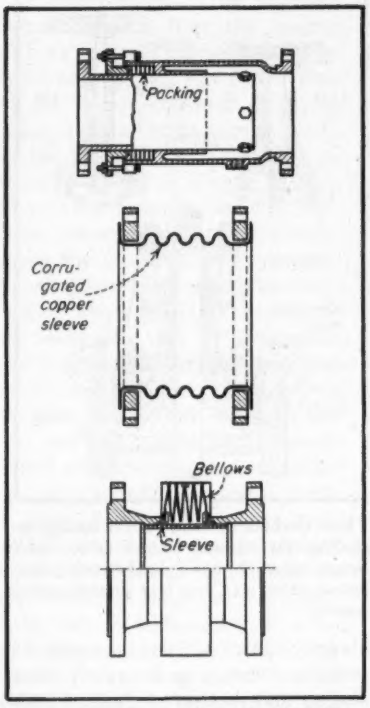
Revolving joints are intended for making pressure-tight pipe connections to revolving equipment. Their construction is generally rather similar to mechanical seals often used in centrifugal pumps. In the typical design illustrated here it will be noted that the seal between the stationary part at the left and the revolving part at the right is made by a spring-loaded sleeve and a rotating graphite ring. Sizes commonly range from 1 to 2 in. pipe size.

Quick-Connect Couplings—These devices are used mainly for connecting metal and rubber hose to pipes or equipment where the connections must be made and broken easily and quickly. Some designs contain internal valves which are automatically opened when the joint is made. In some types the coupling is held together by cam-loaded balls retained in the female portion, which ride in a groove in the male portion when the joint is completed. An annular seal tightens with pressure. In another type (Evertite) the coupling halves are positively coupled together by a pair of lever-operated cams on opposite sides of the coupling which not only seat in a groove in the male portion, but also serve to force the male portion against a gasket in the female portion to make a pressure-tight seal. Couplings of such types are made in most piping materials and in sizes in the range from about ⅛ to 3 in.

Expansion Joints—Expansion joints or other flexible devices are used in pipe lines where thermal expansion is greater than can be accommodated



Four special pipe joints including: (top) ball joint (Barco), and swivel joint (Chiksan); (bottom) rotating joint (Anco), and quick-connect coupling (Evertite).



Three types of expansion joint including: (top) packed slip type; low-pressure corrugated metal joint; high-pressure steel bellows joint.

by the natural flexibility of the line. Pipe bends and loops are sometimes used for the purpose. If not, expansion will ordinarily be handled with one of two general classes of expansion joint: (1) packed slip joints, and (2) bellows joints. In joints of the slip type, one end slides within the other, being sealed to it by a stuffing box containing packing. One type uses plastic packing applied with a pressure gun. In the packless bellows type joint, the bellows element is generally metal, although rubber joints with a single convolution are used for moderate pressures and vacuum at temperatures to 180 deg. F. The metal packless joints are of two general types: seamless, corrugated construction (with metal reinforcing rings externally located between the corrugations for higher pressures); and diaphragm construction, with the bellows formed of metal rings welded together at both their outer and inner peripheries. This type of construction requires no reinforcement and gives exceptionally long expansion. A new design of this type (Titeflex) employs diaphragms formed into a wavy cross section which permit an expansion of five times the compressed length. Expansion joints come in a wide variety of sizes, construction materials and pressure ratings.

Flexible Connections—Short lengths of corrugated flexible metal hose with end connectors for attaching to pipe are often used as flexible elements in piping to isolate sound and vibration. A very common type of application is in lines running to and from compressors.

Metallic Valves

So far as general principles is concerned, what is said in this section will apply also to non-metallic valves.

Valve types are extremely numerous. Many are general-purpose valves, some are highly specialized for a single kind of use. However, without going into detail regarding the many types, it is possible to study certain common characteristics such as (1) function, (2) types of device used to control the flow through the valve, (3) methods of moving the flow-controlling device, (4) methods of preventing leakage to or from the surroundings, (5) valve construction methods, and (6) more common construction materials used.

The general function of all valves, of course, is to stop or control the rate of flow. Valves of the first type are usually intended to be fully open or fully closed and are called stop valves. Valves which can be used to control flow rate between closed and fully open are referred to as throttling valves. Some types of throttling valve cannot be closed tight, but others are capable of tight closing and therefore can also be used as stop valves.

Most sorts of valve are intended primarily for manual operation. However manual valves as a rule can be provided with a power operator if that is necessary because of the large size of the valve, or because it is in an inaccessible location and must be operated from a distance. On the other hand, there are other types of valve which operate automatically, without attendance. Hence, there is a major distinction between manually operated valves (or power-operated, manually controlled valves) on the one hand, and automatically operated valves on the other.

It will be convenient to give a further breakdown of valve functions bearing in mind that despite the similarity of function, there are a great many types used for each purpose. In the following tabulation a few of the types are named under each function. The letters (M) or (A) after the various functions indicate that valves for this purpose are predominantly Manual or Automatic.

1. Control flow rate in either direction (M or A)
- Stop valves
  - Gate valves
  - Cocks and plug valves
  - Slide valves and blast gates
  - Piston valves
  - Liquid-sealed valves
- Throttling valves
  - Globe, angle and Y valves
  - Needle valves
  - Balanced valves
  - Special plug valves
  - Butterflies and dampers
  - Diaphragm and pinch valves

2. Prevent flow in reverse direction (A)
- Check and stop-check valves
- Pump foot valves

3. Control downstream pressure (A)
- Regulating or reducing valves
- Gas cylinder regulators

4. Control upstream pressure (A)
- Safety and relief valves
- Back-pressure valves

5. Permit flow only of preferential fluid (A)
- Traps
- Air valves

Flow Control Mechanisms—There are only five fundamentally different methods used to control or stop flow in valves, although many different mechanisms are used. (1) The first method is to push a disk or plug into or against an orifice so as to close the opening entirely, or make it smaller. This is the method used in globe, angle, Y and needle valves, and in balanced valves which are a double-disk modification of the globe valve. (2) The second method is to move a sliding surface which may be flat or cylindrical across an orifice so as to close it entirely. Occasionally this method is also used to effect partial closure for throttling. This is the method used in gate and plug valves, slide, piston and sleeve valves. (3) The third method is to rotate a disk or ellipse about a diameter within a short length of pipe so as to effect more or less complete closure. This principle is used in butterfly valves and dampers. (4) The fourth method is to compress a flexible material forming the flow passage or part of the flow passage so as to close or partly close the passage. This method is found in some types of diaphragm valves and in pinch valves. (5) The last method, an old one which is not much used today because of its limita-

tion to very low pressure differentials, is to lower a gate or dam into a liquid pool in the path of flow, so as to produce a liquid seal. Valves of this type are not commercially available but are constructed on the job for such uses as chamber sulfuric acid plants.

Closure Movement Mechanisms—In nearly every type of valve the device which transmits movement to the closure mechanism is a critical part of the design. Usually this is a stem which moves endwise, or rotates, or both. In most valves this stem must extend from inside of the valve, which is under pressure or vacuum, to the outside which is generally at atmospheric pressure. In a few types of valve such as check valves, traps, solenoid valves and some safety and regulating valves the motivating force for valve movement is within the pressure zone and the stem as such may not be needed. In valves using a stem, the method of stem operation may be an important factor in the description and choice of the valve. These methods are listed as follows:

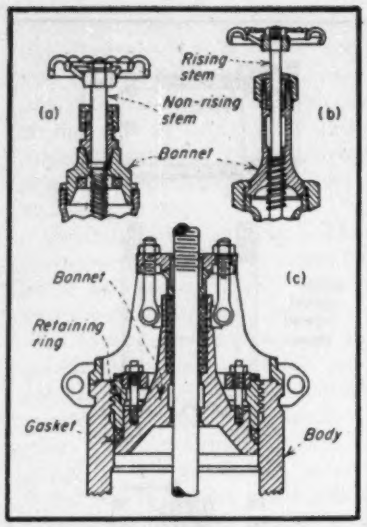
Valve stem:
1. Turns only
   - Non-rising-stem gate valves
   - Most plug valves and cocks
   - Rotating-gate valves (usually quick-opening)
   - Butterfly valves
2. Slides only
   - Gate valves, outside-screw-and-yoke (O S & Y) type
   - Quick-opening globe and gate valves
   - Slide, piston and sleeve valves
   - Balanced (usually automatic control) valves
   - Outside-spring safety valves
3. Slides and turns
   - Globe, angle, Y and needle valves
   - Rising-stem gate valves
   - Wedge-seated tapered-plug valves
   - Diaphragm and pinch valves

When the stem is threaded, as it is in many important types of valve, the location of the thread—whether inside or outside the valve body—is often an important factor in choice of a valve type. For non-corrosive service the thread is often inside the valve body, either screwing into the closure itself, as with non-rising-stem (NRS) gate valves, or screwing into the valve body as in most small globe, angle, Y and needle valves. However, for corrosive and high-temperature service, it is often desired to keep the stem thread out of contact with the fluid handled. In this case the valve body is provided with a yoke outside the bonnet. The stem thread turns in a "nut" which is part of the yoke or attached to it. Two methods of operation are used in this particular. In most O S & Y gate valves the handwheel turns without rising. It is carried on a bushing supported by the yoke, while the stem, prevented from turning, screws back and forth in a nut attached to the handwheel. In O S & Y globe valves the handwheel usually rises with the stem, which is attached securely to it. The nut in this case is in the yoke. Rising-stem valves of the various types have the disadvantage of requiring more headroom than NRS valves. But they have an important advantage in showing the position of the valve closure by showing how much stem is exposed.

Valve-Sealing Methods—In most valves there are at least two points at which the valve must be sealed against loss of pressure from the inside. The stem must be sealed, which requires some mechanism that will be pressure-tight and still allow the necessary movement of the stem. In addition the valve must allow assembly and disassembly of the stem and the internal parts within the body. This is generally provided by means of a removable part of the body which is called the bonnet. The stem passes through the bonnet and the bonnet usually contains the stem-sealing device. A method is therefore needed for sealing the bonnet to the body, which still permits ready disassembly. A third point at which the valve must be sealed, of course, is to the piping attached to it. The methods used here are identical with those for joining pipe and fittings. Finally, lubrication is used for sealing of valve surfaces in lubricated plug valves.

Stem Sealing—The commonest method is to use a stuffing box containing a flexible packing material such as formed asbestos suitably lubricated, or Teflon shreds, square or wedge rings or chevron rings. Teflon has become one of the most important valve packings for severe process uses. Whatever the packing material, it is compressed into the stuffing box and against the stem by means of a packing nut, or a gland. Sometimes, for special purposes such as packing lubrication or inert gas sealing of the valve, a spacer called a lantern gland is installed in the stuffing box between the lower and upper rings of packing, thus providing a space within the packing for introducing the lubricant or sealant through the side of the box.

The stuffing box method of sealing always requires a certain amount of periodic attention to insure a perfect seal, so that packless methods of sealing have gained popularity, especially where corrosive or hazardous materials are being handled. One method of avoiding package which is widely used in chemical valves is to interpose a rubber, neoprene, plastic or Teflon diaphragm between the bonnet and the valve body proper. In some types the diaphragm is pushed down onto a dam across the flow passage by the action of the stem and a compressor, and in this case no further closure of the flow passage is needed. In another type of valve the diaphragm seals the stem to the bonnet joint in a fairly convention type of Y valve, thus separating the valve disk and interior from the stem, stem threads and bonnet.



Three methods of valve bonnet sealing, including: (a) screwed bonnet in an NRS bronze valve; (b) union bonnet rising-stem bronze valve; (c) Crane type pressure-sealed bonnet.

Another method which is similar in principle to the last named is to substitute a metallic bellows for the non-metallic diaphragm. This scheme has been used extensively in small radiator valves and more recently has been applied to automatic control valves, high vacuum valves, and occasional manually controlled valves where absolute leaklessness is required. Such valves usually have a stuffing box outside the bellows seal as a second line of defense in case of bellows rupture.

Bonnet Sealing—The simplest form of bonnet seal, which is used in many

smaller brass valves, is the so-called screwed bonnet. Here the bonnet and body are both threaded, with the bonnet screwed into the body. This has the disadvantage of requiring turning engagement between the body and the bonnet. This is avoided in the union bonnet by slipping a loose nut or union bonnet ring over the bonnet and screwing it onto the body, holding the bonnet securely in place. The joint between bonnet and body is sealed with a gasket in most cases. This method is used in the smaller valve sizes, particularly in brass and bronze, and sometimes in cast iron and steel, and forged steel. In the larger sizes such a point would become difficult to assemble and disassemble.

In larger valves and in many chemical valves of materials such as stainless steel, where galling makes the use of threads difficult, the bonnet is supplied with a flange and is attached to the body by bolts, rather than the union ring just described. The joint between body flange and bonnet flange is made tight just as in the case of flange-jointed pipe by using similar flange faces and suitable gaskets. This type is known as the bolted bonnet. One simple variation of this idea often used in smaller valves, especially chemical valves which may require frequent disassembly for maintenance, is to secure the bonnet by means of a U-bolt which holds the bonnet at both sides and passes around the body. This is called the U-bolt, clamp or clip-type bonnet.

When valves become still larger, the weight of the flanges in the higher pressure designs tends to become excessive. An important means of reducing the weight is to eliminate the body flanges and weld the valve into the line. However, this still leaves the problem of the bonnet flanges and ready maintenance. Two methods which eliminate the bonnet flanges have come into use in recent years, especially in high-pressure steam valves, but also to a lesser extent in high-pressure process valves. The first of these is the so-called pressure-sealed bonnet which is an adaptation of the pressure-sealing method often used on high-pressure process vessels. Here the cylindrical bonnet slides into a cylindrical portion extending upwards from the valve body. A special ring gasket in a depression in the bonnet seals against the bonnet, the body, and a heavy ring which is screwed into the body after the bonnet is in place. An initial seal is obtained by pulling the bonnet upward against the gasket by means of bolts. In operation the internal pressure forces the bonnet against the gasket even more securely as the pressure increases.

A second way to eliminate the bonnet flanges in high-pressure valves is the lip-sealed bonnet developed by Crane. Here the pressure load is carried by heavy threads on the bonnet which is screwed into the body similarly to the simple screwed bonnet in small valves. Around the joint both body and bonnet are flared out to form lips which are sealed by a light bead of weld metal. If the bonnet must be removed for repair, the bead is ground off and the bonnet unscrewed. After repair the joint may be repeatedly re-sealed by welding.

Valve Fabrication—The commonest methods of constructing valve bodies are casting and forging. In the latter case the passages are machined in the solid forging. Both methods have their proponents in the case of valves for the higher pressures. Valves of some types in the smaller sizes are sometimes made by machining from bar stock in the desired metal. Finally, a method which has rather recently been introduced is to fabricate the valve from sheet and plate metals by welding. This method is somewhat unusual except for low pressure blast gates, but it has met success in both gate and plug valves for moderate pressures, in such metals as stainless, Monel and carbon steel.

Valve Materials—In speaking of valve materials we often refer to body and trim. Trim includes such parts as the stem, the plug, disk or other closure, and the seat if a removable seat is used. In many valves the body is of a cheaper metal, such as cast iron or bronze, and the trim of more expensive materials with special characteristics, such as stainless, Stellite, nitrided steel, Teflon (seats in needle valves), and so on. In mixing metals in this way it is always necessary to consider the effect of possible electrolytic corrosion. In practice, when this possibility exists, the trim is chosen so that it will be protected by the body metal.

An almost endless number of metals and alloys can be used in valve construction. A great many commercially useful metals which can be cast or forged are in fact so used. In many cases, however, valves of special corrosion resisting materials will have to be made to special order. The following list shows most of the metals and classes of alloys ordinarily used for valve bodies:

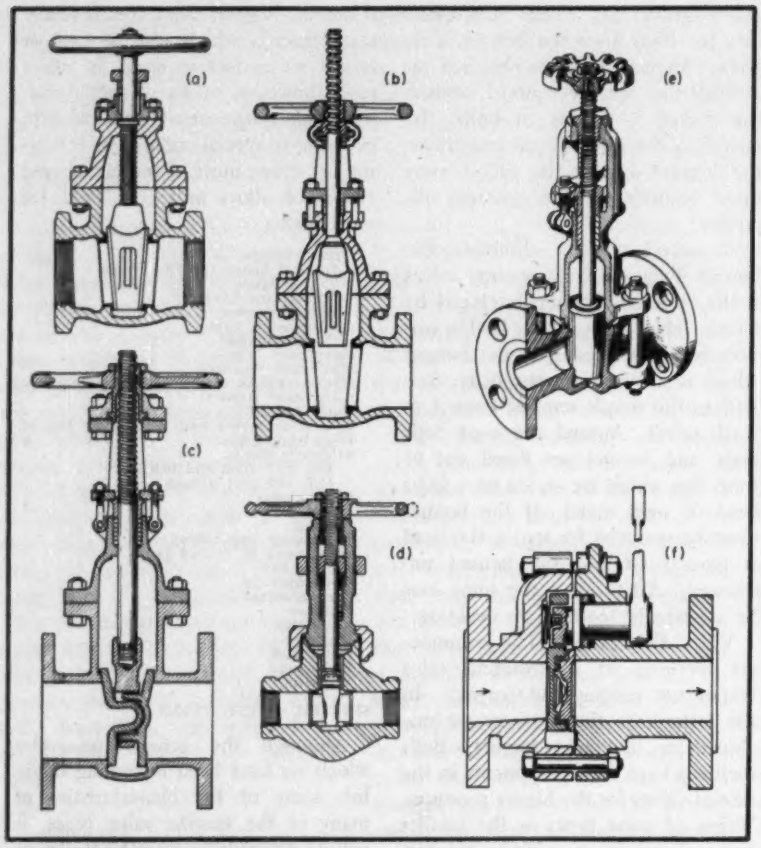
- Copper alloys
  - Leaded brass (steam brass)
  - Tin bronzes
  - Manganese bronze
  - Silicon bronze
  - Aluminum bronze
  - Copper-nickel
- Gray cast iron
- Malleable cast iron
- High-strength cast iron (semisteels)
- Alloy cast irons
- Carbon steel
- Low-alloy steels such as Mo, Cr-Mo, Ni
- High alloy steels
- Stainless steels
  - 304, 347, 316 and others
  - 410, 420 and others
- Pure nickel
- Monel
- Inconel
- Aluminum and alloys
- Hastelloys B, C and D
- Aloyco 20
- Carpenter 20
- Ampco metal
- Duriron
- Durichlor
- Durimet
- Chlorimet
- Hard lead
- Worthite

SPECIFIC VALVE TYPES

Although the general principles which we have been discussing establish some of the characteristics of many of the specific valve types, it will be desirable to examine the more important types in greater detail.

Gate Valves—Gate valves are intended as stop valves, rather than throttling valves. Throttling tends to erode the seat and gate (wire drawing) so that gates should be operated full open or full shut. Gate valves are cast, forged, or fabricated by welding. Because the gate rises out of the flow passage, and the passage runs straight through, gate valves have exceptionally low pressure drop. They are made for pressures as high as 4,000 psi.

Principal design variations, aside from minor modifications resulting from the method of fabrication, relate to the design of the gate or "disk," the seats and the stem, and to the method of bonnet attachment. There are four main variations in disk design in conventional gate valves. These include the solid wedge which seats rigidly between two seat faces inclined to the flow path at the same angles as the disk faces; and the one-piece flexible disk which has a certain amount of spring between faces so that, in high temperature service, the disk will not wedge in the seat too



Gate valves and special gate-valve types: (a) NRS gate valve; (b) OS&Y gate valve; (c) gate valve design for stainless steel (Walworth); (d) high-pressure forged-steel gate valve (Vogt); (e) Crane plug-gate valve; (f) quick-opening rotating-gate valve.

firmly to be withdrawn. There are two further types of disk consisting of two or more pieces, the double-wedge disk which is used extensively in chemical valves, especially those of stainless steel; and the double parallel-seat disk. In the double-wedge type the two disks are in contact through a ball-and-socket joint so that they can accommodate themselves to any change in seat angle. They are free to rotate independently, which helps to distribute wear. In the parallel-disk type a wedge arrangement between the disks releases the pressure against the seats before the gate starts to rise when it is opened. On closing, the gate moves into closed position before the reverse action takes place, wedging the disks against the seats. Such valves are used mainly on cold water, oil and gas service.

In many gate valves the seats are not renewable but are machined directly into the body. If necessary they can be re-faced in place. However, valves for severe service do often have removable seats which are secured by screwing or welding into the body.

Unusual Gate Valves—There are also a number of unusual types of valve which are more closely allied to gate valves than to other sorts. One is the Crane plug gate in which a non-rotating tapered plug is substituted for the gate in what is otherwise much like a normal gate valve. This valve is a rising-stem, outside-screw type, made in stainless 316 and Monel, and in sizes from ¼ to 2 in. It has the advantage of straight-through flow combined with ability to throttle. Another gate type of unique design is the Crane-Paul venturi-ball valve in which a metal ball freely held in a movable cage is used to seal off a circular port in a venturi-shaped passage. This valve also is suitable for accurate throttling control and is said to be especially easy to operate owing to the rolling of the ball into or out of the seat.

In this valve the ball cage is moved by the valve stem. When the valve is open the cage is lifted and with it the ball, presenting an unobstructed flow passage. In closing, the cage is lowered out of the bonnet until the ball hits a stationary stop opposite the discharge port. Further lowering of the cage wedges the ball against the discharge port. However, the ball tends to seat tight under fluid pressure without the locking action of the cage. In opening, the cage first unlocks, then rolls the ball off the seat and up the side of the bonnet. These valves are made in carbon-Mo steel and stainless 316, for 150, 300 or 600 psi. pressure and in sizes from 1 to 8 in. or smaller, depending on rating.

Although it looks like a plug valve, DeZurik Shower Co. makes an unusual gate valve with a cylindrical body and a rotating vane carried on a shaft concentric with the axis of the cylinder. The vane or rotating gate is faced with flexible material such as rubber. When the valve is open the vane is off to one side. As it closes it rotates toward the outlet port and moves toward it until it wedges tight in its extreme closed position. This action is secured by making the vane face and seat eccentric to the shaft.

Rotating-Gate Valves—There is one type of gate valve in which the body contains a pair of parallel surfaces with a flow passage cut through them perpendicularly. A gate, attached at one side to a shaft parallel to the flow passage, slides between the parallel body surfaces as the shaft rotates. In one position it is out of the flow passage and the valve is open. At the other extreme of its travel it slides across and closes the flow passage. Such valves are made in two principal variations. In one type the gate disk seals tight on one side only, so the valve must be used for flow in only one direction. In the second type the disks seal on both sides to accommodate flow in either direction. Such valves are made tight by spring pressure between the disks, or spring pressure supplemented by wedge action. They are used chiefly as quick-opening valves since only a small motion of the operating lever is needed. However, in large sizes, the handwheel may be geared down for extra power, thus sacrificing the quick-opening feature.

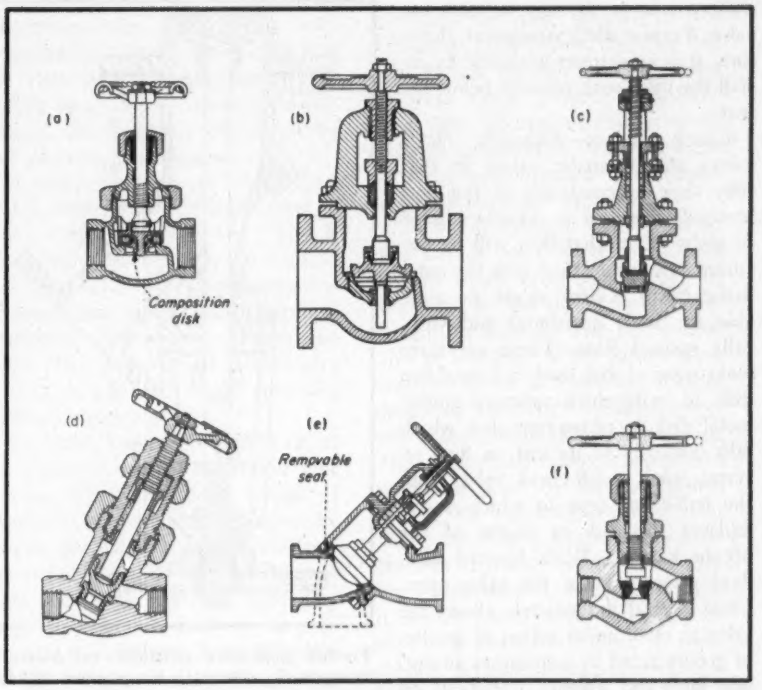
Slide and Blast Gates—Valves of these types are used mainly in con-

trolling flow of air in ducts, or of low-pressure liquids and suspensions where tight closing is unnecessary. Generally they are of light construction, with the gate a metal plate sliding in guides within the body and no means provided for sealing the gate tight at the edges. In some types the gate is pulled upward into the open through a slot which may be packed for tightness, or may rely simply on the narrowness of the slot to prevent much leakage. In other tighter designs a bonnet and packed stem are provided.

Quick-Opening Valves—Except for plug valves, which open on a quarter turn of the stem, and the rotating gate valve mentioned above, most manual valves are slow-opening through the action of a screw on the stem. However, for special purposes most of the conventional types such as usual gate and globe valve designs can be made quick-opening by use of a sliding stem and operating lever. For example, Hoke makes small instrument-panel valves of the needle type in this way, with a toggle lever to hold either open or shut. Quick-opening valves are not used where danger of excessive water-hammer is present.

Globe, Angle, Y and Needle Valves—All these valves are variations of the basic globe type. A globe valve has a partition, separating the inlet and discharge sides of the body, which is parallel to the flow direction. In this is an orifice which serves as the seat. Hence, the flow must take two 90-deg. turns as it passes through. In an angle valve, one of these turns is eliminated, since one flow path enters the valve perpendicular to the seat. In a Y valve the partition containing the seat is at about 45 deg. to the flow path and hence has about the same total change in direction as an angle valve. Needle valves are simply globe valves with a long tapered plug for the disk, designed for close control. They may be of either globe or angle type. All valves of these types are suitable for throttling. However, their flow resistance is greater than that of gate valves. That of the Y valve is well below the resistance of globe valves.

The principal variations in globe valves, aside from those arising from the method of construction, lie in the design of the disk, the stem and the bonnet. There are three principal types of disk: (1) The composition disk type has a disk containing a ring of some suitable non-metallic material which is forced against the seat. This type is not suitable for throttling, but is popular for less severe service because of its ease of replacement, and because dirt on the seat cannot damage it. (2) The metal disk, which is a shallow disk with a seating surface usually of spherical shape, bears against a conical seat, so as to produce line contact. This type is suitable for most types of service, although hard foreign matter on the seat may cause a leak and consequent wire drawing. (3) The plug type disk is a relatively long tapered plug, seating in a tapered seat of the same angle. This type is the one best suited for throttling since it has a long contact surface. The plug approaches the characteristics of the needle valve plug in this regard, and permits close control of the flow rate.



Globe, Y and needle valves: (a) composition-disk brass globe valve; (b) low-pressure iron globe valve with metal disk; (c) high-pressure OS&Y forged-steel globe valve; (d) forged-steel Y valve; (e) alloy cast iron Y valve showing conversion to angle type; (f) high-pressure forged-steel needle valve (Vogt).

As in the case of gate valves, the seats of globe, angle and Y valves may be either integral (machined in the body), or removable and renewable. One useful type of Y valve has the body split and flanged along the line of the 45-deg. seat, with a plate containing the seat inserted between the flanges. Such a valve can be converted from Y to angle type simply by turning half the body through 180 deg. along the line of the split. Y valves are increasing in popularity for process use because of good throttling, relatively low pressure drop, ability to pass suspended solids readily over the seat, and ease of seat renewal in the split type.

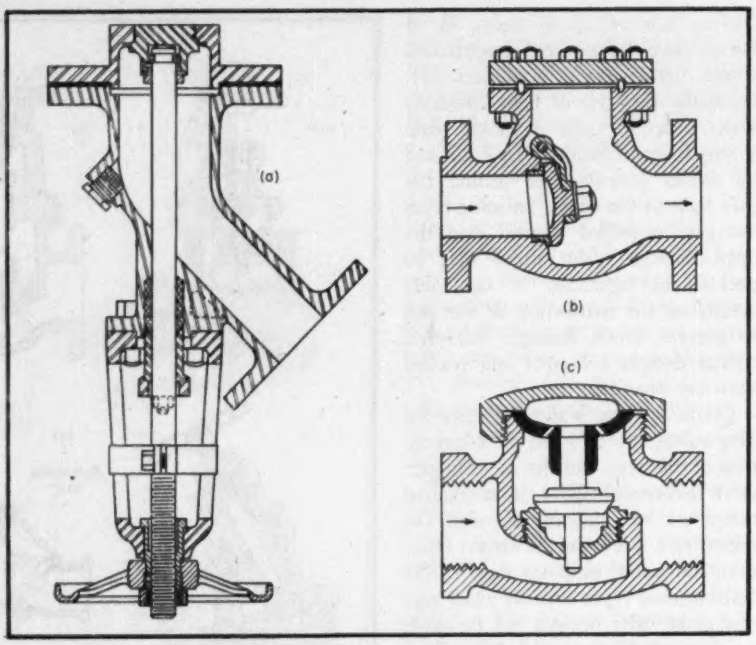
A Y-valve modification important in process work is the flush bottom-outlet valve for tank bottoms. Here the stem follows the "run" and the outlet the Y-branch. There are two main variations: (1) the disk rises into the tank to open, and (2) the disk lowers into the body to open.

In installation of globe and similar valves the question of whether the higher pressure side should be above or below the disk always has to be considered. Generally it is better to have pressure above the disk, since the pressure helps to keep the valve tight. With pressure below the disk on a hot line, the stem will cool somewhat when the valve is closed, thus tending to pull the disk away from the seat. However, if there is any possibility of the disk coming loose from the stem, then with pressure over the disk

there would be no way to open the valve. From a safety standpoint, therefore, it is sometimes advisable to install the valve with pressure below the seat.

Check Valves—Although check valves are automatic valves in that they close automatically if the flow reverses, they are so closely related to globe valves that they will be discussed here rather than with the automatic valves. Check valves are available for both horizontal and vertically upward flow. There are three main types of disk used: a hinged-flap disk, in swing-check valves; a guided metal disk or piston-type disk which falls vertically to its seat on flow reversal, used in lift-check valves; and the ball-check type in which a ball replaces the disk or piston of the lift-check type. With forward flow, fluid pressure keeps the valve open. Flow reversal immediately allows the valve to close under action of gravity, or gravity aided by a spring or an outside lever and weight. Variations on these basic designs depends chiefly on pressure rating, flow direction, and on whether or not some method of cushioning the shock of closing is needed. A stop-check valve is basically a piston-type check valve to which a handwheel and stem have been added to permit holding the automatic piston check closed, or to limit its travel. Such valves find their main use on boiler outlet connections to prevent flow from the main into any boiler which is at lower than main pressure. A foot valve is a special type of check used to keep liquid in the suction pipe of a pump so as to hold its prime. A simple form uses a leather disk. For large foot valves the use of multiple orifices and disks is common.

Balanced Valves—Although balanced valves are used mainly for automatic control or in pressure regulators, they are closely related to globe valves and so will be mentioned here. The purpose in using a balanced valve is to reduce the amount of operating effort required. This fits in closely with the requirements of the diaphragm operators used on the majority of automatic control valves. In a balanced valve there are two seats and two disks, flow being split between the two orifices so that there is pressure under one disk and above the other. A true balance is usually not achieved because, to permit assembly, the lower disk must be small enough to pass through the upper orifice. This means that the pressure against the upper disk will somewhat over-balance the pressure on the lower disk. But the degree of unbalance can be kept reasonably small. Most balanced valves are designed to throttle and to have certain characteristics of flow rate vs. stem movement. Generally they are unable to close tightly.



Further globe-valve variations: (a) Aloyco flush-bottom tank valve; (b) high-pressure swing-check valve; (c) low-pressure lift-check valve.

Plug Valves—Plug valves are a development of the simple plug cock. They are made in a considerable number of types, but the kind most used in the process field is the lubricated, tapered-plug valve. One characteristic of plug valves and cocks which is fairly unique with this class is the ease with which they are adapted to multi-port construction. In the three-way type the plug usually contains a single L-shaped passage which, on a quarter turn, will connect either ports 1-2 or 2-3. In a variation of this type, with a T-shaped opening in the plug, a turn of 180 deg. will give any of three connections, 1-3, 1-2 or 2-3. In the four-way type the plug contains two cut-outs on opposite sides which, on a quarter turn, can connect the ports either in the order 1-2 and 3-4, or 1-3 and 2-4.

Plug valves may use either a cylindrical or a tapered plug, most of them being of the latter type. With lubricated plug valves the lubricant seals the plug to prevent leakage between the plug and its seat within the body. It also helps to make the valve turn readily. In tapered-plug valves the lubricant pressure, applied beneath the small end of the plug, can also act as a hydraulic jack to move the plug slightly away from the seat in case of sticking. In non-lubricated plug valves, which may be used if lubrication is undesirable, or a satisfactory lubricant cannot be found, the design usually permits the plug to be unseated slightly by endwise movement before the plug is turned. In the Homestead type there are two levers, an operating lever and a sealing lever. Before turning the plug the sealing lever is moved, which turns a screw to jack the plug away from the seat. Then the plug is turned and the sealing lever is returned to its original position. In the large manual and power-operated Rotovalves made by S. Morgan Smith Co. for water and gas, the endwise motion needed to unseat and re-seat is introduced automatically at the beginning and end of each movement of the plug.

In conventional types of lubricated plug valves the stem is attached to the large end of the plug and the valve

is packed by using either a separate gland, or the whole cover (bonnet), to force resilient packing against both the top of the plug and the side of the stem. An interesting variation of this idea is found in the Nordstrom high-pressure Hypreseal valve. Here the plug is inverted and turned by a separate stem keyed to it. The bearing of the plug against the seat is adjusted separately from the stem packing by an adjustable resilient bearing at the bottom (large end of the plug). The stem is screw-threaded into the valve body, so that the threads can take the line thrust on the stem. Packing of the threaded stem is accomplished by injecting plastic packing material into an annular space around the stem. The lubricant passage through the stem is provided with several check valves in series to prevent the possibility of lubricant backing out under high line pressure.

The necessity for lubricating plug valves more or less frequently, depending on the type of service and the frequency of valve operation, resulted a few years ago in the development of the compressible type of lubricant by Nordstrom. This lubricant, Hypermatic, is a dispersion of gas in lubricant, which is compressible to about half its expanded volume. When it is fed under pressure into the valve it is compressed, after which it continues to expand and feed automatically into the valve lubricant passages only as rapidly as needed. This considerably reduces the frequency of lubrication and saves on labor expense.

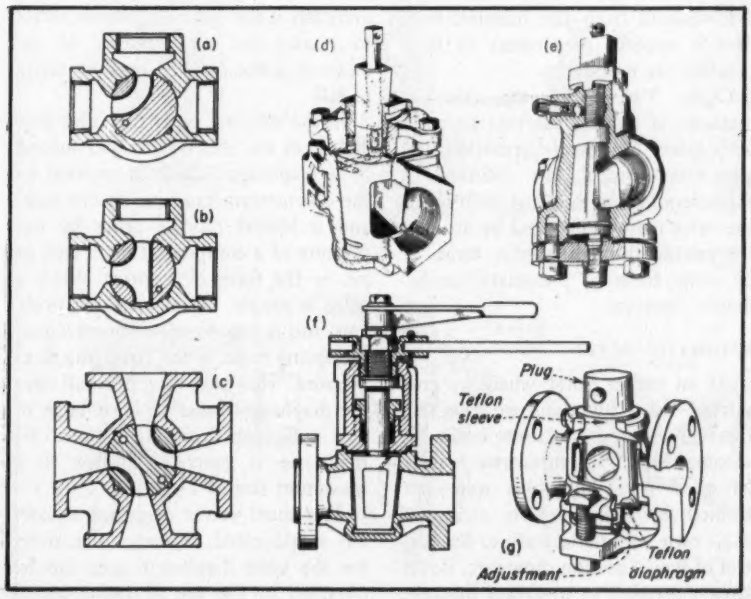
A recent development which eliminates need for use of lubrication in tapered plug valves is the Type F Durco valve developed by the Duriron Co. This valve has a bottom-adjusted reversed plug which seats within a reinforced Teflon sleeve lining the body. The properties of Teflon give a positive seal and ready operation without lubrication.

Butterfly Valves—Butterfly valves are a development of the simple pipe damper. They have the advantages of simplicity, extremely short face-to-face length, good flow control characteristics and ability to be built in extremely large sizes with relatively light construction. They are built for all pressures up to 2,500 psi. Since they give straight-through flow, they have very low pressure drop. Ordinarily such valves will not close bubble-tight although tight closing is possible through use of a rubber-lined body. R-S Products Corp. makes one such valve with a loose rubber liner which is said to give tight shut-off against 100 psig. In this maker's valves the slightly elliptical disk is machined at the edges to seat parallel to the cylindrical body when the disk has been turned through 77½ deg. from its wide open position. Butterfly valves lend themselves readily to all methods of operation including manual, manual-controlled power-operated, and automatic controlled.

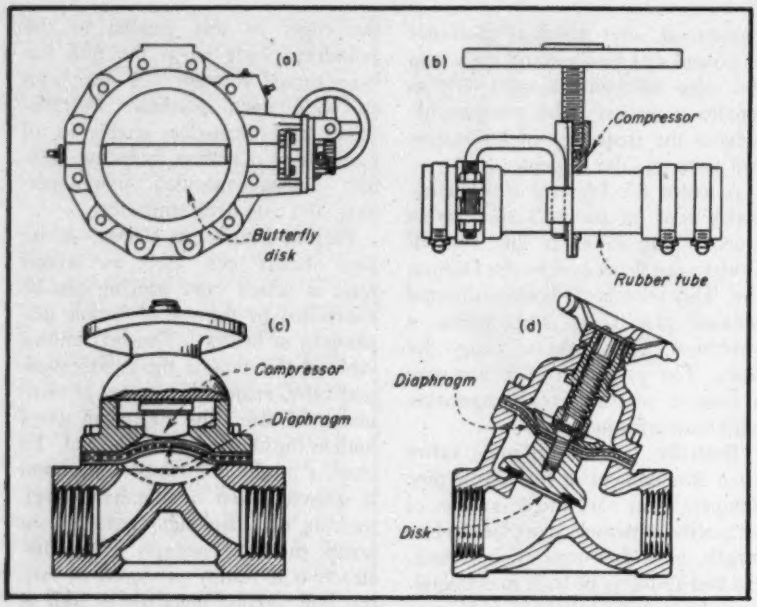
Packless Diaphragm Valves—As we have already seen, there are several ways in which valve packing can be eliminated by the use of flexible diaphragms or bellows. The best known valve of this type is the Saunders-patent valve, made by a number of manufacturers. Here the diaphragm serves both as the closure and as the seal. To close, a mushroom-shaped compressor is screwed down by the handwheel, pushing the diaphragm onto a dam across the flow passage. This construction is readily produced in various non-metallic materials as well as in metals. Metal valves can easily be lined with plastics or rubber. A more recently developed diaphragm valve is the Crane type which is essentially a Y valve with the stem passing through a rubber or synthetic rubber diaphragm installed in the bonnet joint. The disk has a pliable facing material to assure a tight seal against the seat. A somewhat similar valve is made by Farris.

Pinch Valves—Developed from the old idea of the laboratory pinch cock for rubber tubing, pinch valves using specially flexible reinforced rubber tubes designed for coupling to pipe have been brought out by several manufacturers. The design is generally very simple, consisting merely of a rubber sleeve with clamp or flange ends and a handwheel-and-screw-operated compressor to pinch the sleeve closed. The compressor is supported from the attached pipe. Farris Flexible Valve Corp. also has a diaphragm-motor-operated valve of this type for remote or automatic control. Pinch valves are made in a variety of sizes from about ¼ to 12 in.

Piston and Sleeve Valves—A sliding piston which uncovers ports in a cylinder is used in certain special types of valves, for example, for the control of air pressure to pneumatic cylinders which power various mechanical operations. One of this group, used in certain process applications, is the Yarnall-Waring seatless valve. This valve is used widely in boiler and pulp digester blow-down. It is a sleeve or



Four types of plug valves, and multi-port arrangements: (a), (b) two- and three-port arrangements for three-way valves; (c) how a four-way valve is ported; (d) standard type of Nordstrom lubricated plug valve; (e) Nordstrom Hypreseal valve; (f) Homestead non-lubricated plug valve; (g) Teflon-sleeve non-lubricated plug valve (Duriron Co.).



Special valves for various uses: (a) wafer-type butterfly valve (R-S Products Corp.); (b) rubber-tube pinch valve (Farris); (c) Saunders-type diaphragm valve; globe-type valve with diaphragm seal (Crane).

plunger type, with the hollow metal sleeve sliding in a ported cylinder with packing above and below the ports. When the valve is open the sleeve ports align with ports in the body. When it is closed the sleeve ports are moved lengthwise of the body until sealed off by the packing.

Solenoid Valves—Solenoid valves do not introduce any new principles so far as the valve closure is concerned. Commonly the valve is of the globe type, with a solenoid operator. Solenoid valves are ordinarily of the open-or-shut type and cannot throttle since a solenoid is either energized or not. Usually the valve is designed to close when not energized, a type referred to as "normally closed." Solenoid valves are often used for emergency shut-off service. However, normally open valves are also available. The most usual method of solenoid valve operation is for the stem to be equipped with an armature which is drawn into the field of the solenoid winding when current passes through the coil. A spring provides the force to move the valve disk and stem to the opposite extreme when current is cut off. However, in larger valves where the operating force or required stroke would be beyond the capability of the solenoid, a small solenoid is provided to control a pilot fluid (usually the fluid being handled). This in turn is applied to a diaphragm operator on the main valve. In some designs the pilot valve is external to the main valve, in others, built into the main valve.

Solenoid valves may be packless in which case the solenoid is attached directly to the valve bonnet. Solenoid operators are also applied to valves with packed stems when isolation of the solenoid from the material handled is needed, or pressure or temperature are too severe.

Other Valve Operators—Various methods of power operation are used with valves for remote operation and automatic control. In addition to the solenoid operator just mentioned the valve may be powered by an electric motor through a gear train, or by some form of pneumatic or hydraulic operator.

AUTOMATIC VALVES

At an earlier point when we considered valve functions we saw that there are several functions ordinarily accomplished by automatic valves. Most of these functions were performed by valves which contained their own automatic features for control of flow direction, flow rate, downstream pressure or upstream pressure. We also noted a class of valves which would pass one but not the other of two or more fluids. The only principal class of automatic valve not self-contained is the control valve which is automatically controlled to give the desired flow rate by means of an automatic control instrument separate from the valve.

Check valves, are automatic valves which prevent flow reversal, but they have already been considered adequately with the globe valves, to which they are closely related. At that point we also showed how balanced valves resemble and how they differ from globe valves. However, balanced valves, and non-balanced types with somewhat similar characteristics, are the basis of most automatic control, so they will be discussed in greater detail here.

Downstream-Pressure Valves—A broad class of automatic valves is made for controlling the downstream pressure—in that is, pressure below the valve—in various flowing-fluid systems. Generally these are known as regulating or reducing valves, or as regulators or reducers. Such valves may be either single-seated (globe) or double-seated (balanced) in type. In every case they operated by balancing the downstream pressure in the valve, or in the pipeline downstream of the valve, against some adjustable force which represents the desired reduced pressure, or is proportional to it. The valve is designed so that it will decrease the flow automatically if the reduced pressure starts to exceed the set pressure, or increase it if the reduced pressure starts to fall.

In the simplest types the valve disk and stem are attached to and moved by a diaphragm which is exposed to the downstream pressure on one side, and is loaded on the other by the pressure of a compressed fluid such as air, or the force of a spring. Such a valve is simple, has no packing problem, and is easy to adjust by changing the spring force or the balancing fluid pressure. However, even in small sizes the diaphragm must be fairly large to give sufficient operating power. So this type is generally limited to a maximum size of 1½ in.

The small valves described usually are single-seated. Greater sensitivity for the same diaphragm area can be obtained by the use of double-seated balanced valves. In this case the valve is ordinarily the same type of diaphragm-motor-operated valve used for

automatic instrument control. It then has a packed stem and a diaphragm contained in a housing carried on a yoke. The balancing force may be either a spring or a weighted lever.

For still greater sensitivity or for larger valves some form of pilot system is used. In the internal-pilot type the pressure of the upstream fluid is used as the pilot pressure. In external-pilot types the pressure of some auxiliary fluid available at constant pressure is used. This may be instrument air, fuel gas or water. Pilot-controlled regulators are of many types but in general they work about as follows: Downstream pressure is applied to one side of a small diaphragm which is balanced by a spring. The diaphragm controls the position of a small pilot valve which in turn controls the flow of pilot fluid to a cylinder and piston, or a large diaphragm. The latter device then adjusts the position of the main valve so as to give the flow rate which will produce the desired downstream pressure.

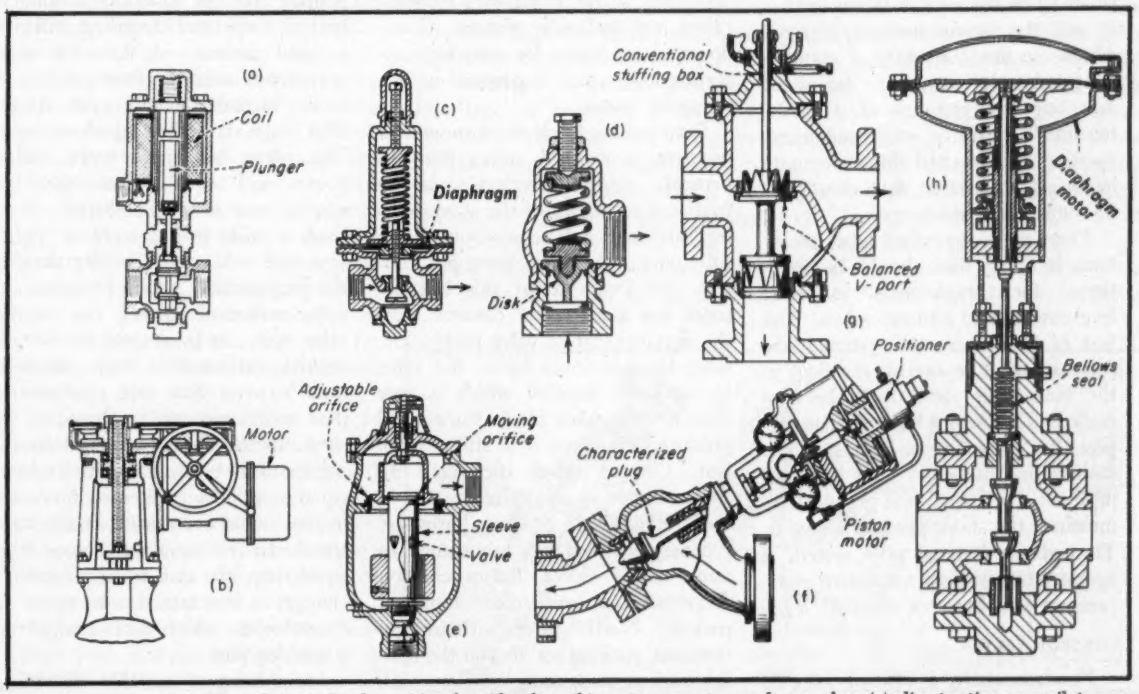
Upstream-Pressure Valves—There are two general types of valve which control the pressure ahead of the valve: (1) safety and relief valves which relieve the pressure in a static pressure system such as a vessel or piping, whenever the pressure exceeds a desired value; and (2) backpressure valves which are used in flowing-fluid systems, to regulate the flow so as to hold a constant pressure above the valve. The first are stop valves—either open or shut; those of the second type are similar in function except that they throttle and control continuously.

Safety and relief valves consist in an angle-type globe valve with pressure under the disk, and a loading spring to hold the disk against the seat until the set pressure is reached. The disk usually differs slightly from the conventional globe type in overhanging the seat and in discharging in such a way as to increase the lift on the disk for quicker opening. There are two principal ways of accomplishing this. One is to surround the seat with an adjustable ring so as to form a sort of expansion chamber as soon as the valve starts to relieve, thus applying the pressure to a disk area larger than that of the seat alone. This causes the valve to "pop" open. A variation is to provide a skirt on the disk so that, as soon as the valve relieves, the fluid is forced to reverse its direction. The reaction effect helps to open the valve quickly.

In most safety valves there is an inside spring which is adjustable from the outside. However, for higher temperature operation the valve usually has an outside spring, which means need for a packed stem. Inside-spring valves are limited in inlet size to about 3 or 4 in., and outside-spring valves to about 6 in. inlet. Outlets are ordinarily larger than the inlet. The term safety valve usually implies a valve of greater, and relief valve, a valve of lesser relieving capacity.

Backpressure valves find their main use in controlling the discharge pressure on non-condensing engines and turbines. They may be single- or multi-port, but in general resemble globe valves with an adjustable loading spring replacing the usual stem and handwheel.

Flow-Regulating Valves—Where a pressure-regulating valve controls the downstream pressure and allows the flow through the valve to vary correspondingly, there is another type of automatic valve which holds a constant flow rate regardless of line pressure variations. For example, the flow rate regulator of the W. A. Kates Co. is made in four ranges from 0.1 to 100 gpm., in pipe sizes from ½ to 2 in. Its principle is quite simple. If the pres-



Power-operated, automatic and control valves: (a) solenoid valve; (b) motor operator on large valve; (c) direct-acting non-pilot regulating valve (Leslie); (d) internal-spring relief valve (Crane); (e) Kates flow-regulating valve; (f) Conoflow piston-motor control valve with special plug for high pressure drop; (g) three-way control valve body for mixing and diverting service (Kieley & Mueller); (h) bellows-sealed control valve with balanced characterized plug (Hammel-Dahl).

sure drop across a fixed-area orifice remains constant, the flow through the orifice will remain constant. But without special means to hold the pressure drop constant within the regulator, any change in either up- or downstream pressure would change the flow rate. Hence, the regulator contains a valve whose opening is maintained automatically to give a constant drop across the orifice. Since the size of the orifice can be adjusted from an external calibrated dial, the constant flow rate can be adjusted to any rate within the regulator range.

Preferential-Fluid Valves—This article cannot go at any length in the various sorts of traps and air valves except to point out that they operate either on temperature difference between the fluid passed and the fluid held back, or on the basis of the accumulation of a certain quantity of the fluid passed. Their main use is to hold back stream and allow discharge of condensate or air, although they are also used in separators for removing an accumulation of one of a pair of immiscible liquids, such as oil from water. The two main classes are the thermostatic type, which contracts and opens under the action of the cooler condensate, but expands and closes when the warmer steam reaches it; and the various mechanical types which use floats, buckets or counterweighted receivers as a means of detecting the presence of a predetermined quantity of condensate, opening a valve until this condensate has largely discharged, then closing before steam can discharge.

There are a few other types of automatic valve that should be mentioned for completeness, including level-control and altitude valves. The first of these is a sliding-stem globe valve actuated by means of a float in the tank where level is to be controlled. The second has a similar purpose, but does it from a distance. In maintaining the water level in standpipes an altitude valve at ground level measures the static pressure above it. Through an internal pilot system it operates to maintain a constant static pressure and hence a constant level.

CONTROL VALVES

Fundamentally, a control valve is a valve of any type which is provided with a powered operator controlled by an automatic control instrument. Many types of valve have been used for this purpose including all the variations of the globe valve, plug cocks, butterfly valves, diaphragm and pinch valves. Control valves are not necessarily throttling valves, although many of them are. Non-throttling types are used for on-and-off control, throttling types for continuous control. Double-seated valves find extensive use for control purposes. However, there is an increasing use of single-seated valves with the development of certain newer and more powerful types of valve operator.

Valve operators have been almost as numerous in type as the variations in valves themselves. Most control valves are powered by diaphragm-motor tops supplied with controlled air pressure from the control instrument. A relatively new type is the piston-motor top with built-in positioner used by such makers as Annin and Conoflow. Since piston motors can use higher air pressure, they can be applied to single-seated valves, which require more power to operate but are claimed to give better flow characteristics for some types of use, for example in shut-off and high pressure-drop service. In addition to these types of valve operator, electric-motor-operated valves are in use, along with solenoid valves and hydraulic pistons. Conoflow has one design for extra high operating load which is powered with a rotary air motor.

Stem sealing tends to be more of a problem in control valves than in manually controlled valves since the frictional resistance of the stem packing can cause a false position of the valve and hence give improper control. To some extent this has become less a matter of concern with the development of valve positioners, since the positioner forces the valve to assume a position which is very close to that called for by the control pressure. However, it is still a problem. Control valves use small diameter stems to minimize friction in the stuffing box. Stuffing boxes are generally provided with lubricators. In some recent valves Teflon chevron rings have replaced older types of packing. Control valves without conventional packing are also on the market, such as those using a bellows seal, and diaphragm and pinch valves.

Control Valve Characteristics—A control valve is a variable orifice which, by its opening, gives a rate of flow as called for by the control instrument. This definition is a theoretical one for reasons inherent in both the valve and the associated piping system, but the valve can be made to fit it quite closely if necessary. One means of approaching this definition is through use of a valve positioner to overcome friction and "hysterisis." Another is through the use of special characteristics in the valve disk, or "inner valve." The "characteristic" of a control valve is a curve which defines the relation between stem travel and flow rate, assuming a constant pressure drop across the valve. The assumption of a constant pressure drop across the valve is ordinarily not an accurate one, since the valve is not the only source of pressure drop in the system. Hence, with flow rate changes, the drop across the valve will change. Also there will be changes within the body, in addition to those across the orifice of the valve. That is, the actual characteristic of the valve is in part dependent on the piping system.

However, the concept of special valve characteristics is still a useful one. There are three principal types of characteristic used. The ordinary poppet type of disk for on-and-off control, if operated throttling, will give a rapid increase in flow for stem movements near the shut point, and slower increases as the valve opens. This type is called quick-opening. The other two main types, called linear, and equal percentage, are widely used in double-seated valves. Each is made in two types, a "plug" type and a V-port type. By shaping the plug portion, which forms an annular orifice of varying size as the valve opens, or by shaping the V to a desired mathematical form, the relation between flow rate change and stem movement can be altered as desired. In the linear type (still assuming a constant drop across the valve), equal stem lifts give equal flow rate increments at every point of the stem travel. In the equal percentage type equal stem lifts give equal percentage changes in flow rate at every point—a characteristic which plots straight on a semi-log plot.

In chosing a suitable throttling type of control valve the object is to match the valve characteristic with the process characteristic. E. Wolff,

writing in *Instrumentation* (Minneapolis-Honeywell), has pointed out that the change in actual characteristic produced by the piping system tends toward the linear when an equal-percentage valve is used. However, a linear valve used in the same piping system tends to change toward the characteristic of the quick-opening type of valve. On this account the equal percentage valve is more commonly used, although there are no hard and fast rules for valve-characteristic selection. Experience and sometimes cut-and-try are the best bases for choice.

Control valves are made in many sizes up to 12 or 16 in. in the globe type, and the larger in other types such as butterfly valves. They are also made in Y and angle types, with stuffing boxes, or bellows seals, with diaphragm valves, or extra high-pressure bodies (e.g., 6,000 psi.). There are many other variations such as three-way valves, venturi-plug valves for high pressure drops, and single-seated valves with tight shut-off which nevertheless are balanced. Hammel-Dahl accomplishes this with a piston type plug, packed to the body, by applying upstream pressure above the plug.

Non-Metallic Piping Systems

For many years the process field has used numerous non-metallic materials for pipe, valves and fittings, among them ceramics, glass and fused silica, glass-lined steel, carbon, asbestos-cement, and rubber. In recent years plastics have come strongly to the fore as piping materials, and at least a dozen of them are now reaching a place of importance.

Chemical Stoneware—This old standby for corrosive service is produced in pipe in diameters up to 60 in. The most common joint for the large sizes and for drainage work is the bell-and-spigot joint, which is caulked and filled with a pouring compound. Other jointing methods include conical flanged joints and cemented-on metal flanges. A new method of jointing pipe to pipe, or to fittings, has been brought out by Robinson Clay Product Co. in the form of a threaded plastic sleeve. The ends of the pipe are supplied with cast-on threads. Pipe comes 3 ft. long, in diameters from 4 to 8 in. The method is suitable for most acidic materials, but not for strong alkalis, HF and a variety of solvents.

Chemical stoneware fittings are provided in many styles including those usual in metal, plus some additional ones primarily for drainage work. Valves include lubricated and non-lubricated plug cocks, stoneware-body diaphragm valves, and a variety of low-pressure dampers.

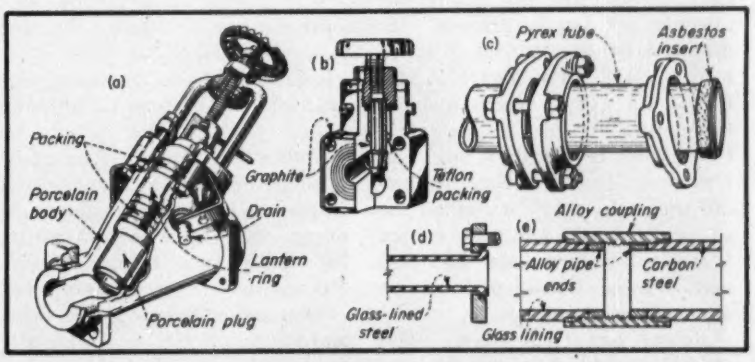
Chemical Porcelainware—Porcelainware pipe is made in diameters of ½ to 8 in. Various types of joint are in use including cemented-on metal flanges and conical flanged joints. Available fittings include ells, tees, crosses, caps, reducers, sight-glass fittings and packed expansion joints. The most unusual kind of valve is of the Y type which can be adapted with some body modification as a flush bottom-outlet valve. Lapp Insulator Co.'s Y valve uses a combined plug and stem which passes through a deep stuffing box equipped with a lantern gland. Some of these valves are now being packed with Teflon wedge rings. Most valves of this type for critical locations, along with the pipe and fittings, are now being armored with fiber glass cloth bonded on with a high strength epoxide resin to prevent major damage in the event the porcelain is broken accidently. This type of armoring is becoming common in the stoneware and porcelain industry. M. A. Knight and U. S. Stoneware are both using similar protection for stoneware pipe, fittings and valves, as well.

Glass—Corning Glass Works is now producing all of its borosilicate industrial glass pipe and fittings, made under the name of Pyrex, with specially heat treated ends said to be 2½ to 3 times stronger than ordinary glass. The pipe comes in inside diameters from 1 to 6 in., and in lengths of 6 in. to 10 ft. The recommended maximum working pressure is 50 psi. in 3-in. pipe, scaling down to 20 psi. for 6-in. pipe. Lengths of pipe and fittings are connected by conical flanged joints with an interface gasket. Molded inserts separate the metal flanges from the conical pipe ends. For field flanging, the end of the pipe can be beaded and by use of a rubber ring behind the bead, can be made up into a joint just as with the conical end pipe.

Available glass fittings include spacers, slip joints, ells, tees, crosses, laterals, return bends and a number of reducing fittings. Valves are made in the form of angle-spigots and straight-through plug cocks, in sizes to 1½ in. Adapters are available for connecting to metal pipe and tubing and to glass-lined pipe. Glass pipe armored with glass fiber tape and epoxy resin is a recent development.

Glass-Lined—Glass-lined pipe produced by the Pfaudler Co. is made in I. P. S. sizes from 1½ to 12 in. for 150 psi. working pressure. Special pipe for higher pressures is available. Joints are a modified Van Stone joint with forged low-carbon steel flanges. Gaskets are used between the abutting glass-coated pipe ends. There is also a method of using screwed couplings of alloy pipe, in which the ends of the glass-lined pipe are tipped with a suitable alloy before glass coating.

Fittings include ells, tees, crosses, return bends, reducers and reducing



Non-metallic components: (a) Lapp chemical porcelain Y valve; (b) National Carbon impervious graphite globe valve; (c) joint for Pyrex pipe (Corning Glass Works); (d), (e) Pfaudler joints for flanged and threaded connections in glass-lined steel pipe.

flanges, hose connectors, and adapters for connecting to glass pipe of similar, larger or smaller diameter. Several types of valve are made in sizes from 1½ to 8 in. Ordinarily these valves use a porcelain disk and seat, although stainless and Hastelloy can be supplied for these parts and for the stem. Valve types include bottom-outlet valves in the flush and globe types, safety valves and line valves. An unusual feature is an extra handwheel independent of the closing mechanism for re-seating the disk or wiping the seat before closing.

Carbon—Impervious graphite pipe is manufactured in nominal inside diameters from 1 to 10 in. Joints are either of the threaded and cemented type, or flanged by screwing and cementing a collar onto the end of each abutting pipe, and pulling the assembly together by means of cast iron split flanges and through bolts. There is also a flexible form of coupling of the packed type, using neoprene seal rings to pack the pipes where they enter a cylindrical graphite sleeve or coupling. The packing is compressed by follower flanges and through bolts. Fittings include ells, tees, crosses, plugs, caps, couplings, nipples and collars for flanges, as well as reducing fittings. National Carbon Co. supplies 1- and 2-in. all-carbon globe valves with Teflon packing. Falls Industries supplies globe valves in sizes of 1 to 3 in. and diaphragm valves, with neoprene or Teflon diaphragms, to 6 in.

Asbestos-Cement—Standard Transite pressure pipe for water and process use is furnished by Johns-Manville in 4-16 in. diameters. There are several methods of coupling. In one, the pipe is grooved near the ends and a sulfur-base cement is poured into the space between the end and a surrounding cast iron flanged hub. The flanged joint so produced is sealed with a gasket. In another type split flanges are secured mechanically to tapered recesses in the pipe ends. Fittings are fabricated of steel and lined with Transite. They are produced in types closely resembling the equivalent flanged ells, tees, crosses, laterals and reducers used with steel pipe. Packed expansion joints are also made in several types.

Rubber and Hard Rubber—Soft rubber is supplied in the forms of flexible rubber pipe in sizes from 4 to 16 in., with rubber-flange ends. In the form of acid hose its diameter range is ¾ to 3 in., internally wire-reinforced if used in suction service. Rubber linings ranging from semi-hard to soft can be installed in fittings and metal pipe (steel, cast iron, wrought iron, spiral welded, etc.) in sizes above about 1¼ in. I. D., and in lengths to 12-20 ft. depending on size. Rubber-lined diaphragm valves are produced in sizes up to 14 in. Pipe, fittings and valves have flanged ends with the lining carried out over the flange. Hard rubber can be supplied in the form of screwed or flanged pipe, fittings and cocks in sizes of ¼ to 4 in. Or pipe, fittings and valves of any size above about 2 in. can be hard-rubber-lined. Hard-rubber linings can be put into both gate and diaphragm valves. Fittings of both solid hard rubber and hard rubber lined are made in a full range of types. Available rubbers include natural and various of the synthetics.

Plastics—Many of the plastics are now being used in piping. Among them are cellulose acetate butyrate (Tenite II), polyvinylidene chloride (Saran), reinforced phenolics (such as Haveg), polyethylene, rigid polyvinyl chloride (unplasticized), polyester-glass fiber products, and glass-reinforced furane resin. Piping applications for such plastics were discussed at length by Bruner and Wayne. (*Chem. Eng.*, pp. 193-204, July 1953). However, as typical of such uses, Saran tubing for use with flared Saran fittings, is made in sizes from ⅛ to ¾ in. Rigid Saran pipe, fittings and diaphragm valves are produced in sizes of ½ to 2 in. (4 in. for the pipe). Saran linings, swaged into steel pipe, come in 1-6 in. I. P. S. sizes. Saran linings are available in cast iron and cast steel fittings, and in plug and diaphragm valves in the same size range.

Polyethylene pipe, valves and fittings (American Hard Rubber's Ace Parian) comes in sizes of ½ to 2 in.

Rigid polyvinyl chloride pipe and fittings come in usual sizes from ½ to 2 in. for standard molded fittings, and up to 6 in. for pipe and specially fabricated fittings. Threaded, flanged and cemented joints are all used. Cellulose acetate butyrate also comes in ½ to 6 in. diameter pipe and fittings, which are joined by solvent cementing. As typical of the glass-reinforced plastics, Knight's Permanite furane resin pipe is made in sizes from 1½ to 12 in., with Permanite fume ducts from 4 to 36 in. Joints are provided by wrapping with glass fabric and resin cement, or the pipe can be supplied with enlarged ends to take a special cast iron split flange.

Codes, Standards and Design

There is nothing to prevent building pipelines as strong as you wish, except the element of cost. Conversely, you can transport a liquid or a gas under pressure in a pipe just thick enough to prevent bursting. Practical engineering judgment and conscience are the determinants.

If a pipeline should burst, or a joint give way, or a gasket blow out, there could be several results—cost, possibility of hurting someone, lost product, and lost time for an entire process.

Fortunately, there is a reasonable intermediate approach in sizing pipe. Engineers, manufacturers, users and others concerned with such matters have joined forces to bring together the best answers from years of experience in making and using pipe, valves, and fittings. When an agreement of good practice is reached and the members of an industry decide to adhere to a certain set of rules, we have a "standard." For example, there are American standards for screw threads and their gages.

Similarly, standards have been developed for piping. There is an American standard code for pressure piping. There are American standards for flanges and other fittings. The pulp and paper industry has a standard which covers the colors to be painted on certain pipelines. But you don't have to adhere to a standard; it is a voluntary agreement.

When the public safety is involved, however, or if workmen's compensation is a factor, then a legal authority may become concerned. Perhaps a municipal government, a state, even a federal authority may come into the picture. This is the beginning of a code. There is no longer a free choice in the matter.

Professional and manufacturers' societies recognize this need for codes. When they write standards, they at-

Table II—Sources of Information on Standards and Codes

1. American Petroleum Institute
2. American Society of Mechanical Engineers.
3. American Society for Testing Materials
4. American Standards Association
5. Chemical Industries Correlating Committee
6. Manufacturers' Standardization Society of the Valve and Fittings Industry
7. Manufacturing Chemists' Association
8. Technical Association of the Pulp and Paper Industry

Table III—Some Important Standards*

API 600	Valve Standards
ASA B 2.1-1945	Pipe Threads
ASA B 16b-1944	Cast-Iron Pipe Flanges and Flanged Fittings, Class 250
ASA B 16bl-1931	Cast-Iron Pipe Flanges and Flanged Fittings (for 800 lb. hydraulic pressure)
ASA B 16e-1939	Steel Pipe Flanges and Flanged Fittings, including supplement No. 1 B 16e6-1949
ASA B 16.9-1951	Steel Butt-Welding Fittings
ASA B 16.11-1946 R 1952	Steel Socket-Welding Fittings
ASA 16.20-1952	Ring-Joint Gaskets and Grooves for Steel Pipe Flanges
ASA 16.21-1951	Non-Metallic Gaskets for Pipe Flanges
ASA B 26-1925 R 1947	Fire-Hose Couplings Screw Threads
ASA B 31.1-1951 also B31.1a-1953	Code for Pressure Piping
ASA B 36.19-1952	Stainless Steel Pipe
ASA B 57.1-1953	Compressed Gas Cylinder Valve Outlet and Inlet Connections
ASA B 60.1-1950	Refrigerant Expansion Valves
ASA (no symbol)	Tolerances for Cylindrical Fits (A primer—not a standard)

* Standards for pipes fabricated from other materials are now under revision.

tempt to use a style which can be adopted by legislative bodies as a legal code. Chemical engineers should be familiar with some standards and codes, even though they may not have prime responsibility for design or safety inspection.

Consider pressure piping, which is used universally throughout the chemical process industries. For refinery practice there are standards and recommended codes of the joint API-ASME committees. In other cases, the American Standards Association's Code for Pressure Piping* may be more applicable.

The Code for Pressure Piping (ASA) was first issued in 1935 as an American tentative standard. It represents a standard of minimum safety requirements for:

1. The selection of suitable materials and reference to standard specifications by which they may be secured.

* This is really a standard but since it has been written with the idea that several states may adopt it as a mandatory code in the next few years, the name Code for Pressure Piping is used.

2. The designation of proper dimensional standards for the elements comprising piping systems.

3. The design of component parts as well as the assembled units, including necessary supports.

4. The erection of these systems.

5. The test of the elements before erection and the completed systems after erection.

It is intended to set minimum safety requirements expressed in language which is intelligible to all who design, manufacture and erect piping systems, but not necessarily to cover the best practices known to the art. Design recommendations are included where they will assist in securing safe piping systems.

The most recent form of this code was issued in 1951 and revised in 1953. Another revision is now being circulated for approval and can be expected in 1954. It will incorporate new materials of construction and practices developed for handling these materials. The ASA is also expected to issue a new color code for piping identification next year.

PIPING SYSTEM DESIGN

Standards and codes have been established to set the minimum safety requirements in the design of piping systems. Some design problems which may concern chemical engineers are as follows:

1. Economical pipe size to handle a given flow.

2. Selection of a suitable means for joining piping components and of sealing joints.

3. Provision for temperature changes and resulting stress changes.

4. Selection of the best valves and their materials for specific service conditions.

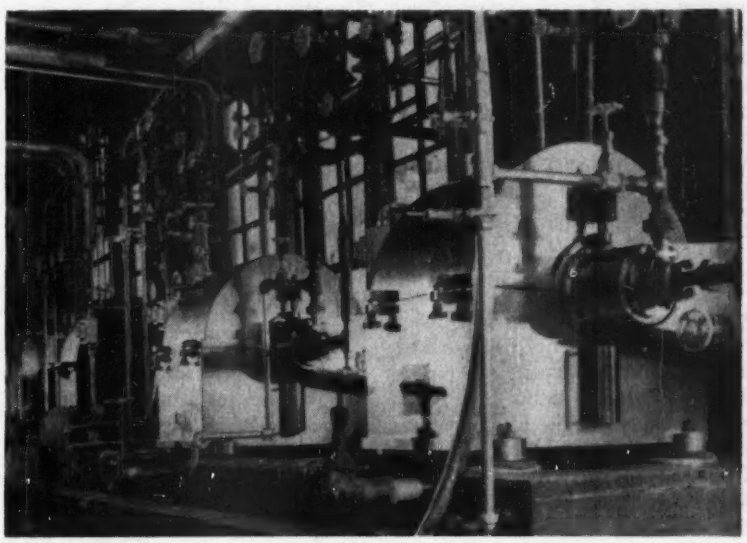
5. Design of anchors, hangers, and other supports and their spacing while providing adequate drainage.

6. Determination of economic insulation thickness.

The most complete book which treats all of these subjects is the "Piping Handbook," edited by Sabin Crocker.

In sizing piping systems, first consideration must be given to carrying the required flow; perhaps this should be considered a problem in fluid flow. After the pipe diameter has been set, the thickness of the wall should be considered. Pipe sizes are standardized on outside diameter in the codes, because it is the outsides of two lengths of pipe which must be joined and sealed. Variations in wall thickness affect the inside diameter only. Cost of pipe increases with thickness and good design practice calls for minimum thickness.

The Code for Pressure Piping (ASA) gives several formulas for the minimum thickness of pipe. Assume that the piping we are interested in starts at the outside wall of the powerhouse. The lines leading from the powerhouse to the operating area are governed by Section 1 of the Code, which covers Power Piping Systems.



Piping is the arterial system of processes, as with these Podbielniak extractors.

Table IV—Manufacturers Supplying Information for This Report

Alloy Steel Products Co., Linden, N. J. (alloy valves)
Alpha Plastics, Inc., West Orange, N. J. (rigid PVC pipe, fittings)
American Car & Fdry. Co., Valve Div., Detroit (plug valves)
American Hard Rubber Co., New York (rubber and plastic pipe, valves, and fittings)
Ampco Metal, Inc., Milwaukee, Wis. (Al bronze pipe, valves, fittings)
Automatic Switch Co., Orange, N. J. (solenoid valves)
Babcock & Wilcox Co., Tubular Products Div., New York (alloy pipe)
Barco Mfg. Co., Barrington, Ill. (ball, swivel, revolving joints)
Black, Sivalls & Bryson, Inc., Kansas City, Mo. (control and regulating valves)
Carpenter Steel Co., Alloy Tube Div., Union, N. J. (alloy pipe, tubes)
Chiksan Co., Brea, Calif. (swivel joints)
Colonial Plastics Mfg. Co., Cleveland (rigid PVC pipe, fittings)
Conoflow Corp., Philadelphia (control valves)
Cooper Alloy Fdry. Co., Hillside, N. J. (alloy valves, fittings)
Corning Glass Works, Corning, N. Y., (glass pipe, valves, fittings)
Crane Co., Chicago (general line of valves and fittings)
Crane Packing Co., Chicago (Teflon and other gaskets, packings)
Crucible Steel Co. of America, Pittsburgh (alloy pipe)
The Duriron Co., Dayton, Ohio (alloy pipe, valves, fittings)
Ever-Tite Coupling Co., New York (quick-connect couplings)
Fairbanks Co., New York (valves, brazed connections)
Falls Industries Inc., Solon, Ohio (graphite pipe, valves, fittings)
Fansteel Metallurgical Corp., No. Chicago, Ill. (tantalum pipe, fittings)
Garlock Packing Co., Palmyra, N. Y. (packings, gaskets, expansion joints)
Grinnell Co., Providence, R. I. (pipe, valves, fittings, hangers)
Hammel-Dahl Co., Providence, R. I. (control valves)
Hoke, Inc., Englewood, N. J. (small valves, regulators)
Johns-Manville, New York (asbestos-cement pipe and fittings)
W. A. Kates Co., Deerfield, Ill. (flow regulators)
Kieley & Mueller, North Bergen, N. J. (control valves)
Maurice A. Knight, Akron, Ohio (chem. stoneware and furane plastic pipe, valves, fittings)
Ladish Co., Cudahy, Wis. (forged steel flanges, fittings)
Lapp Insulator Co., LeRoy, N. Y. (porcelain pipe, valves, fittings)
Leslie Co., Lyndhurst, N. J. (control and regulating valves)
Minneapolis-Honeywell Regulator Co., Philadelphia (control valves)
National Carbon Co., New York (graphite pipe, valves, fittings)
National Lead Co., New York (lead and lead-lined pipe, valves, fittings)
Okadee Co., Chicago, Ill. (rotating-gate valves)
Pennsylvania Flexible Metallic Tubing Co., Philadelphia (metal hose)
The Pfaudler Co., Rochester, N. Y. (glass-lined pipe, valves, fittings)
Parker Appliance Co., Cleveland, Ohio (flare and compression couplings)
Horace T. Potts Co., Philadelphia (stainless weld fittings)
R.-P. & C. Valve Div., American Chain & Cable Co., Reading, Pa. (valves)
R-S Products Corp., Philadelphia (butterfly valves)
Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J. (hose, rubber and rubber-lined pipe)
The Ric-wiL Co., Barberton, Ohio (pre-insulated pipe)
Rockwell Mfg. Co., Nordstrom Valves Div., Pittsburgh (plug valves, valve lubricants)
Saran Lined Pipe Co., Ferndale, Mich. (plastic-lined pipe, valves, fittings)
S. Morgan Smith Co., York, Pa. (large non-lubricated plug valves)
Timken Roller Bearing Co., Steel & Tube Div., Canton, Ohio (alloy pipe)
Titeflex Inc., Newark, N. J. (expansion-joint bellows)
Trent Tube Co., East Troy, Wis. (stainless and alloy tubing)
Tri-Clover Machine Co., Kenosha, Wis. (stainless tube and pipe fittings)
Tube Turns Inc., Louisville, Ky. (weld fittings and flanges)
U. S. Stoneware Co., Akron, Ohio (stoneware and porcelain pipe, valves, fittings)
Henry Vogt Machine Co., Louisville, Ky. (forged steel valves, fittings, flanges)
Walworth Co., New York (general line of valves and fittings)
Watson-Stillman Fittings Div., Roselle, N. J. (forged steel fittings)
Welding Fittings Corp., Newcastle, Pa. (welding fittings)

But if you're working in a refinery, this same piping is classified under Oil Piping Systems in Section 3 of the Code. The best approach for the chemical engineer is to stick to Section 3—Oil Piping Systems, including oil vapor, refinery gas, and gasoline recovery plants.

Paragraph 325 of the Code, on Thickness of Pipe, gives a regular formula and an alternate:

$$t_m = \frac{PD}{2S + 2yP} + C$$

where t_m = design minimum thickness of the pipe wall in inches; P = maximum non-shock internal service pressure, psig.; S = maximum allowable stress in the pipe wall due to the maximum internal service pressure at the service temperature, psig.; C = corrosion allowance, in inches, plus the thread depth or groove; and y = a coefficient having a value from 0.4 to 0.7 depending on temperature and type of steel. Alternatively,

$$t_m = \frac{PD}{2S} + C$$

The second formula is most frequent in refinery practice. It is more conservative. Refineries have worked out tables of retirement for piping over the years and rather than make extensive revisions in plant routine, the alternate formula is still used. However, the first formula is favored for new construction since it allows thinner walls.

There are some pitfalls to avoid in using the thickness formula. The manufacturing tolerance on pipe is 12½ percent. A nominal 1-in.-wall pipe may be as thin as 0.875 in. at its weakest point. For calculating the maximum allowable pressure in such a line, you should use the minimum thickness, i.e., 0.875 in.

P is the design pressure and for piping it is equal to 100 percent of the maximum operating pressure, or the setting on the relief valve. C is defined by a good guess, plant practice, or some reliable corrosion data. With a value for t_m specified, pipe may be ordered by I. P. S. nominal diameter, schedule number, or wall thickness.

The allowable stress of piping materials S is given in the Code by first defining the chemical composition of the material. Both ASTM and API designations are used. Pipes made of these materials are tested for bursting strength and the allowable stress is one-quarter of this value at moderate temperatures. As the temperature is increased the allowable stress decreases.

This decrease of allowable stress as temperature increases shows up in the Code's tables for flanges. Just to give one example, a carbon steel flange with ring joint facing, rated as 150 lb., can be used for higher pressures below 500 deg. F., and the 150 lb. rating must be lowered at higher temperatures. At 950 deg. F. the standard 150 lb. flange is good for only 40 psig. For help with fine points such as these—and there are many in piping design—the selected references at the end of this report will be helpful.

CREDITS

The author acknowledges particularly the assistance of the trade organizations, Copper & Brass Research Assn. and Manufacturers' Standardization Society of the Valve & Fittings Industry; and of the following manufacturers: Crane Co., Walworth Co., and Cooper Alloy Foundry. In addition, many other manufacturers supplied much valuable information. Table IV lists these sources and gives a general idea of the types of products involved.

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Chemical Engineering Fundamentals

CE REFRESHER

Compression and Expansion—I

THOMAS E. CORRIGAN, Research Engineer, Mathieson Chemical Corp., Niagara Falls, N. Y.
A. F. JOHNSON, Sales Engineer, Carrier Corporation, Cleveland, Ohio

Processes which take place at high pressure are becoming increasingly important in the chemical industry. Combustion under pressure is the subject of considerable experimental investigation. The hydrogenation of coal is a high-pressure process, as well as the manufacture of polyethylene, ammonia, and many other important chemicals. The fuel, air supply, or other feed gases must be compressed to the operating pressure, and the engineer must be capable of calculating the work of compression in order to estimate the economics of the process. Although the detailed design of the compressors is the work of mechanical engineers, the chemical engineer should be familiar with the fundamental principles involved in work calculations.

That's what we'll try to do in the next few installments. Some of the methods of calculating compression work will be reviewed, both for ideal and non-ideal gases. This will also include a brief discussion of the polytropic process.

Expansion can be considered a negative compression. However, there are cases where calculations for expansion are more involved than just putting a minus sign in front of a work of compression formula; we'll try and cover these next month.

Methods of Compression

There are two fundamental methods of compressing gases: (1) Positive displacement and (2) Non-positive displacement. The positive displacement compression is accomplished by either rotary blowers or reciprocating compressors. Centrifugal compressors are non-positive displacement machines. This discussion will be limited mainly to reciprocating and centrifugal compressors since rotary blowers are not meant for high compression ratios. Each has its own advantages. The proper choice of which to use depends on such factors as the compression ratio required, type of drive (steam turbine, electric motor, or gas engine), allowable oil contamination in discharge gases, maintenance facilities and personal preference. Usually, reciprocating compressors are best for low capacity and high compression ratios while centrifugal are best for high capacity and low compression ratios.

Centrifugal compressors are high speed machines. Therefore, the best drives are steam turbines designed for the same high speeds and directly connected. Also, it is often possible to fit a compressor and its turbine into the over-all heat balance of a plant.

The compression process itself may be classified as follows:

Type of Work: Non-flow or Cyclic

Type of Process: Isothermal or Adiabatic

Type of Gas Being Compressed: Ideal or Non-Ideal

Any compression may be classified as a combination of these three types* such as non-flow, isothermal compression of an ideal gas, or a flow adiabatic compression of a non-ideal gas. There are eight combinations possible and we shall discuss the methods of calculating work for each of these eight combinations.

Flow and Non-Flow Work

An example of a non-flow compression is the compression stroke of a piston in a cylinder in which there are no valves for gas to enter or leave the cylinder. The non-flow compression is of academic interest in developing means of calculating work, and of interest to the engineer only as a step in the overall cyclic or flow process. It has been established in a previous section (*Chem. Eng.*, Sept. 1953, p. 242) that if the step is reversible, the work can be determined from the following expressions:

$$dW = pdV \text{ and } W = \int pdV.$$

The flow work is the one of chief interest to the engineer because in all commercial compressors there is a steady flow of low pressure gas to the intake and a steady discharge of high pressure gas. The cyclic compression consists of three steps:

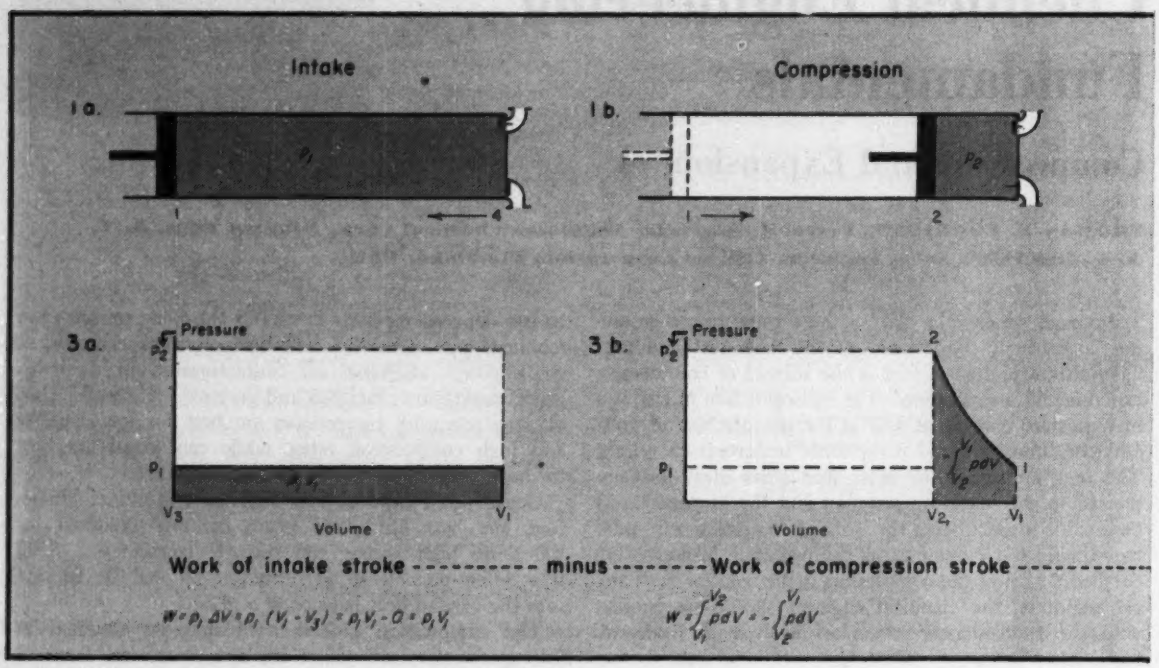
1. The intake stroke—The piston is drawn back and Valve A (Fig. 1a) opens allowing gas to enter the cylinder.
2. The compression stroke—Valves A and B are both closed and the piston moves from position 1 to 2 compressing the gas from p_1 to p_2 (Fig. 1b).
3. The exhaust stroke—The piston moves from position 2 to 3 with Valve B open, expelling the gas at pressure p_2 (Fig. 1c).

* This does not include the polytropic process which will be discussed separately.

Meet our Co-author . . .

A. F. JOHNSON

This month Al Johnson joins Tom Corrigan as co-author of CE Refresher. He'll let us in on some of his practical compressor "know-how". Mr. Johnson has been an Applications Engineer and, more recently, a Sales Engineer with the Carrier Corporation. Born in Michigan in 1912, our co-author was a West Point graduate in 1935, returning to teach there from 1942-6. His contribution of industrial and teaching experience will enrich this section of your refresher.



It is the sum of these strokes that constitutes the cyclic or flow compression process. This can be shown on a p-V diagram, Fig. 2. For simplicity, we have assumed that the exhaust stroke clears all the remaining gas from the cylinder—that there is no clearance volume. In an actual compressor there is some clearance volume, but this as well as any friction involved in the machine, will be neglected for the thermodynamic analysis.

The work of the cycle is the sum of the work of the individual steps. Let's consider the work of each step in the cycle and determine the sum. (See also Fig. 3 and Fig. 4):

1. The intake is a constant pressure process taking place at p_1. From Fig. 3a, $W = p_1\Delta V = p_1V_1 - p_1V_3$. But since $V_3 = 0$, $W_1 = p_1V_1$.

2. The compression stroke represents work done on the system. During this stroke both valves are closed, making this a non-flow process. The work equation is:

$$W = \int_{V_1}^{V_2} pdV.$$

3. The exhaust stroke is a constant pressure process taking place at p_2. Therefore, $W = p_2\Delta V = p_2(V_2 - V_2) = p_2V_2 - p_2V_2$; but since $V_2 = 0$, $W = -p_2V_2$.

The work for the cycle is the sum of these three steps:

$$\Sigma W \text{ (cycle)} = p_1V_1 - \int_{V_1}^{V_2} pdV - p_2V_2 = -\int_{p_1}^{p_2} Vdp$$

Since $\Delta pV = p_2V_2 - p_1V_1$,

$$\Sigma W \text{ (cycle)} = -\Delta pV - \int_{V_1}^{V_2} pdV.$$

Differentiating the product (pV), $d(pV) = pdV + Vdp$, and integrating both sides,

$$\Delta pV = \int_{V_1}^{V_2} pdV + \int_{p_1}^{p_2} Vdp$$

Transposing ΔpV and $\int Vdp$,

$$-\int_{p_1}^{p_2} Vdp = \int_{V_1}^{V_2} pdV - \Delta pV$$

Therefore,

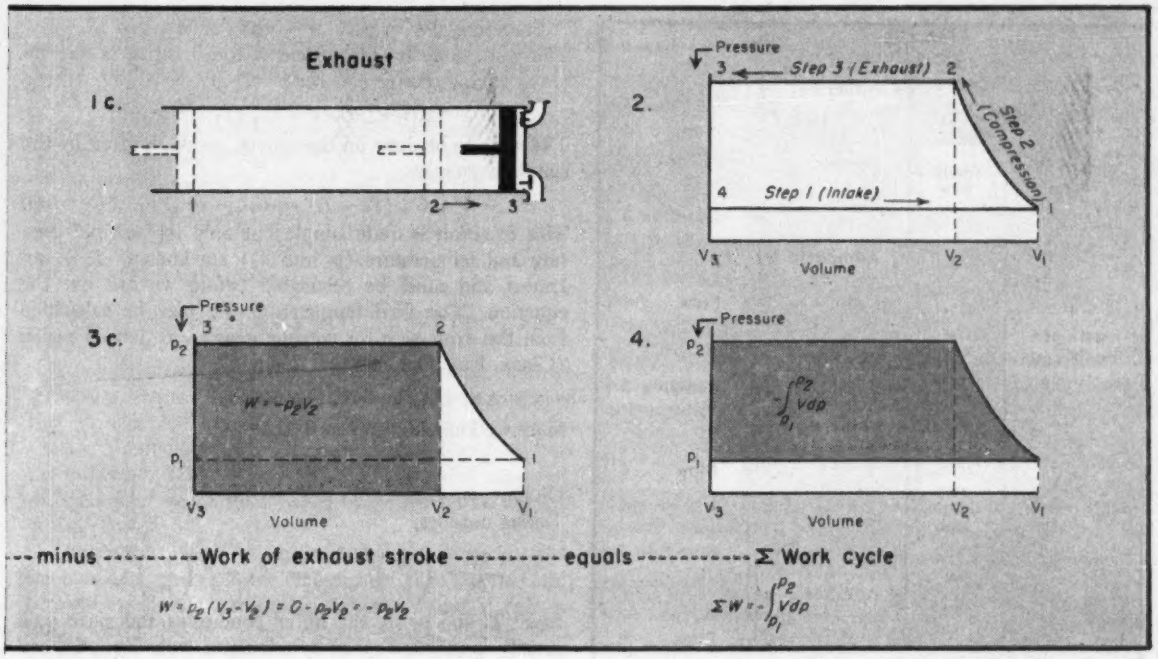
$$W \text{ (cycle)} = -\int_{p_1}^{p_2} Vdp.$$

For any flow compression $\int Vdp$ is a measure of the work that must be applied, exclusive of friction. This is called the "flow work".

Adiabatic or Isothermal Process

In an adiabatic compression, no heat escapes from the gas during the process. An isothermal compression is one in which the heat transfer is rapid enough to keep temperature constant at the initial value. In a commercial compressor the compression is neither adiabatic nor isothermal but lies somewhere between the two. However, either adiabatic or isothermal conditions may be approached in certain cases. During a single stroke of the machine the compression is so rapid and the heat transfer so slow by comparison that practically no heat is removed and the process is almost adiabatic. Therefore, a single stage compression may be assumed to be adiabatic.† (A single stage compression is one in which the gas is compressed to the desired pressure with just one pass through the compressor.)

† This statement does not apply to compressors using water jacketed cylinders for which the compression may approach the isothermal.



Sometimes the gas is compressed by stages. Gas originally at 1 atm. may be compressed first to an intermediate pressure, p_2, cooled to the original temperature, compressed still more, then recooled, and again compressed. This may be carried on for several stages until the desired pressure is reached. If this is done for several stages and the gas is cooled to the initial temperature after each stage, the process approaches being isothermal. To be truly isothermal, an infinite number of stages would be required.

If the number of stages is too small to approach isothermal conditions but large enough so that the process can not be considered adiabatic, the compression is referred to as a "polytropic process." There have been some empirical equations developed for the calculation of polytropic processes. These equations will be discussed in a later section.

Reversibility

The fundamental differential equations relating the thermodynamic energy functions are written for reversible processes. Although no actual engine compresses the gas reversibly, because of friction, it is quite useful to calculate the power needed in the reversible process. This serves as a goal which the actual machine may approach. The relationship between the calculated reversible performance and the actual performance is called the efficiency. This is the ratio of the work actually performed to the energy required by the machine to perform that work.

Calculation of Work of Compression

The work required to compress a gas in a reversible process may be calculated directly from the thermodynamic energy functions. This is true for both ideal and non-ideal gases and for both adiabatic and isothermal processes. The calculation for ideal gases is much simpler than for the non-ideal but with the present industrial trend toward higher pressures, the latter is becoming more important. Because ideal gas calculations are simpler, we shall consider them first. The types of calculation will be discussed in the order shown in Fig. 5.

1. IDEAL GAS, ISOTHERMAL PROCESS, NON-FLOW WORK

It was shown previously (*Chem. Eng.* Sept. 1953, p. 241), that for the non-flow process, $dW = pdV$, or

$$W = \int_{V_1}^{V_2} p\,dV$$

Since for ideal gases we do have a simple relationship between p and V, $pV = RT$, we may write

$$W = \int_{V_1}^{V_2} p\,dV = \int_{V_1}^{V_2} RT\,\frac{dV}{V} = RT \ln \frac{V_2}{V_1}$$

Or, the equation may be put in terms of p instead of V.

$$W = \int_{V_1}^{V_2} p\,dV = \int_{p_1}^{p_2} RT\,\frac{dp}{p} = -RT \ln \frac{p_2}{p_1}$$

The reason for the negative sign is that work is done on the system.

2. IDEAL GAS, ISOTHERMAL PROCESS, FLOW WORK

In discussion above on flow and non-flow work we have seen that for cyclic or flow work, $dW = -V\,dp$ or $W = -\int V\,dp$. For an ideal gas $pV = RT$. Therefore,

$$W = -\int RT\,\frac{dp}{p} = -RT \ln \frac{p_2}{p_1}$$

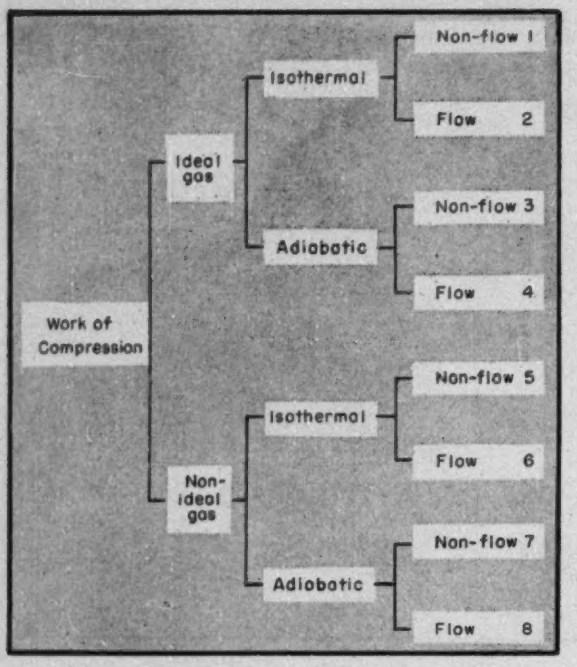


Fig. 5—COMPRESSION WORK calculations are discussed below for the eight cases shown.

So, for the ideal gas in an isothermal compression, the flow and non-flow work are the same.

3. IDEAL GAS, ADIABATIC PROCESS, NON-FLOW WORK

In the adiabatic process no heat flows into or out of the system during the compression and the gas heats up during the process. For a given volume, more work is required for the adiabatic compression since a higher pressure is required; and for a given pressure change more work is required than for the corresponding isothermal compression, but a greater volume of gas is delivered at the higher pressure.

For an adiabatic process $dq = 0$, and since our thermodynamic calculations are limited to the reversible process, the entropy change must also be zero.

$dS = dq_r / T$ and $dq_r = 0$, Thus $dS = 0$

For this reason the adiabatic reversible process is called an isentropic process.

The work of compression for the adiabatic process is best calculated from the energy functions. Since we know that the term we desire (non-flow work) is pdV and we also know that $dS = 0$, we may choose an energy function from the fundamental differential equations.

$$dU = TdS - pdV \quad (1)$$

$$dH = TdS + Vdp \quad (2)$$

$$dG = -SdT + Vdp \quad (3)$$

$$dA = -SdT - pdV \quad (4)$$

We see that the expression involving both dS (since it is known to be zero in this case) and pdV is the one to use. $dU = TdS - pdV$ and since the process is isentropic, $dS = 0$ and $dU = -pdV$.

Therefore, $dW = pdV = -dU$; or $W = -\Delta U$

The work done by the system is the negative of the internal energy change and since

$$\Delta U = \int C_v dT = C_{vm}(T_2 - T_1)$$

The work to be done on the system, $-W$, is given by the simple expression:

$$-W = C_{vm}(T_2 - T_1) = (C_{pm} - R)(T_2 - T_1) \quad (5)$$

This equation is quite simple but only the original pressure and temperature (p_1 and T_1) are known. T_2 is unknown and must be calculated before we can use the equation. The final temperature, T_2, may be calculated from the expression for entropy which was derived earlier (*Chem. Eng.* Oct. 1953, p. 237).

$$\Delta S = C_{pm} \ln T_2/T_1 - R \ln p_2/p_1$$

Since we know that $\Delta S = 0$, then

$$C_{pm} \ln T_2/T_1 = R \ln p_2/p_1$$

Dividing by C_{pm}, $\ln T_2 / T_1 = (R / C_{pm}) \ln (p_2 / p_1)$

Taking antilogs,

$$\frac{T_2}{T_1} = \left(\frac{p_2}{p_1}\right)^{R/C_{pm}} \quad \text{or} \quad T_2 = T_1\left(\frac{p_2}{p_1}\right)^{R/C_{pm}} \quad (6)$$

Since T_1 and p_1 are the initial conditions and since p_2 is usually specified, T_2 may be calculated from Eq. (6), and used in Eq. (5) to calculate work.

4. IDEAL GAS, ADIABATIC PROCESS, FLOW WORK

Since flow work is the negative integral of Vdp, and dS is still zero, the appropriate energy equation is: $dH = TdS + Vdp$. From this for adiabatic flow work

$$-dW = Vdp = dH \text{ (since } dS = 0).$$

$$-W = \int dH = \Delta H = C_{pm}(T_2 - T_1) \quad (7)$$

We can calculate the final temperature

$$T_2 = T_1\left(\frac{p_2}{p_1}\right)^{C_{pm}/R}$$

and use this value in Eq. (7) to calculate work

5. NON-IDEAL GAS, ISOTHERMAL PROCESS, NON-FLOW WORK

Since $dT = 0$, and since for the non-flow process, $dW = pdV$, the appropriate energy equation is: $dA = -SdT - pdV$. From this the isothermal work of compression is:

$-dW = -pdV = dA$ (since $dT = 0$); or, $-W = \Delta A$.

ΔA may be calculated from its relationship with ΔU

$-W = \Delta A = \Delta U - T\Delta S$.

The equation is not useful in this form since internal energy correction charts ($U^* - U$) are not generally available and, therefore, the substitution

$$\Delta U = \Delta H - \Delta(pV)$$

must be made. Therefore,

$$-W = \Delta H - \Delta(pV) - T\Delta S. \quad (8)$$

Now, since we are dealing with non-ideal gases the term ΔH generally is not zero even for the isothermal process; for this case the term $\int C^*_{pm}\, dT$ is zero but the sum of the correction terms usually is not zero. Therefore,

$$\Delta H = (H_2^* - H_2) - (H_1^* - H_1) \quad (9)$$

This may be evaluated from enthalpy correction charts and used in Eq. (8). The term ΔpV may be written as ΔzRT and since the process is isothermal

$$-\Delta pV = RT(\Delta z) = -RT(z_2 - z_1)$$

This term may be evaluated from the compressibility factor chart and used in Equation (8).

ΔS for non-ideal gases is given by the expression:

$$\Delta S = C_{pm} \ln\left(\frac{T_2}{T_1}\right) - R \ln\left(\frac{p_2}{p_1}\right) - (S_2^* - S_2) + (S_1^* - S_1)$$

For the isothermal process,

$$-T\Delta S = -RT \ln\left(\frac{p_2}{p_1}\right) - T(S_2^* - S_2) + T(S_1^* - S_1)$$

The correction terms are evaluated from the entropy correction charts. These substitutions could be made in Eq. (8) but that would make a complicated equation for a rather simple calculation. It is suggested, therefore, that the quantities ΔH, ΔpV, and $T\Delta S$ be calculated separately and the numerical values found can then be substituted in Eq. (8).

The calculation of the reversible work of compression for non-ideal gases is more complicated than for the ideal because the simple relationship between p and V ($pV = RT$) does not hold. One method of calculating work would be to use the more complicated equations of state, such as the Beattie-Bridgman equations to establish the relationship between p and V. This becomes extremely complicated and is, therefore, seldom used.

Another method is to use diagrams such as enthalpy-temperature, temperature-entropy and enthalpy-entropy charts. These provide the most convenient means of calculating work but they are available for only a few of the more common gases and for practically no mixtures. These charts and their uses will be discussed in more detail next month.

A method which probably is the most useful for the widest range of substances and for mixtures of non-ideal gases is the use of the energy function calculations in conjunction with the enthalpy and entropy correction charts. This method assumes the validity of the law of corresponding states but does not introduce any appreciable error since this law seems to hold for most of the common gases.

6. NON-IDEAL GAS, ISOTHERMAL PROCESS, FLOW WORK

Since flow work is $-\int V dp$, the most likely energy expression is $dG = -SdT + Vdp$
and since $dT = 0$, $-dW = Vdp = dG$ and $-W = \Delta G$.
Since no free energy correction charts are available, we shall make use of the expression $\Delta G = \Delta H - T\Delta S$.
Then

$$-W = \Delta H - T\Delta S \qquad (10)$$

and as in the non-flow case,

$$\Delta H = (H_2^* - H_2) - (H_1^* - H_1)$$

Therefore,

$$-T\Delta S = -RT \ln\left(\frac{p_2}{p_1}\right) - T(S_2^* - S_2) + T(S_1^* - S_1)$$

These quantities may be evaluated by use of the correction charts and used in Eq. (10).

7. NON-IDEAL GAS, ADIABATIC PROCESS, NON-FLOW WORK

Since dS is zero in the adiabatic reversible process, the proper energy equation for non-flow work is $dU = TdS - pdV$. Since $-dW = pdV$ $dU = TdS - dW$, and since $dS = 0$, $-dW = dU$ and $-W = \Delta U$.
Because there is no internal energy correction chart, we use the relation

$$\Delta U = \Delta H - \Delta(pV)$$

to get the expression for work in terms of ΔH instead of ΔU.
Also,

$$\Delta H = C_{pm}(T_2 - T_1) - (H_2^* - H_2) + (H_1^* - H_1) \qquad (11)$$

This equation can not be used until T_2 is known. The final temperature, T_2, is calculated from the knowledge that the entropy change is zero.

$$\Delta S = 0 = C_p \ln\left(\frac{T_2}{T_1}\right) - R \ln\left(\frac{p_2}{p_1}\right) - (S_2^* - S_2) + (S_1^* - S_1)$$

This equation may be solved by the trial and error method for T_2. Once T_2 is known, ΔH may be solved for, using Eq. (11). The term $\Delta(pV)$ may be written in either of two forms:

$$\Delta pV = (p_2V_2 - p_1V_1)$$

or

$$\Delta pV = R(z_2T_2 - z_1T_1)$$

Either form may be solved by the use of the compressibility factor chart once T_2 is known. The work may then be evaluated from $-W = \Delta U$.

8. NON-IDEAL GAS, ADIABATIC PROCESS, FLOW WORK

Since the flow work is equal to Vdp, the proper energy expression for its calculation is $dH = TdS + Vdp$.
From this it is seen that for adiabatic reversible flow work $dW = -Vdp = -dH$ and $-W = \Delta H$.
The expression for ΔH is the same as before

$$-W = \Delta H = C_{pm}(T_2 - T_1) - (H_2^* - H_2) + (H_1^* - H_1)$$

and T_2 is calculated from the entropy expression as in the previous case.

$$\Delta S = 0 = C_{pm} \ln\left(\frac{T_2}{T_1}\right) - R \ln\left(\frac{p_2}{p_1}\right) - (S_2^* - S_2) + (S_1^* - S_1)$$

T_2 is solved for by trial and error.

NOMENCLATURE (Consistent Units)

A	Total work function
C_{pm}	Mean heat capacity at constant pressure
C_p	Heat capacity at constant volume
C_{vm}	Mean heat capacity at constant volume
d	Differential operator
G	Free energy (net work function)
H	Enthalpy
p	Pressure
q	Heat added to a system
q_r	Heat added to a system, reversible
R	Universal gas constant
S	Entropy
T	Absolute temperature, K. or R.
U	Internal Energy
V	Volume
W	Work
z	Compressibility factor
Δ	Finite change in a property
Σ	Summation
$*$	Superscript indicating ideal gas property

Compression Work Problems

Example 1—Calculate the work of compression when 1000 pounds of methane are compressed from atmospheric pressure to 250 psig. for the following cases:

(a) An isothermal non-flow compression at 100°F.
(b) An adiabatic non-flow compression.
(c) An isothermal flow compression.
(d) An adiabatic flow compression.

Assume methane to be an ideal gas.

Solution (a) *Isothermal non-flow compression*—This is the hypothetical case where the gas is compressed in one stroke of a piston and where heat transfer is rapid enough to conduct the energy away as heat through the walls of the cylinder as fast as the energy is put in as work.

The equation for reversible work is $dW = pdV$ and

$$W = \int_{p_1}^{p_2} pdV.$$

We have shown that for an ideal gas (since $pV = RT$)

$$W = \int_{p_2}^{p_1} RT\,\frac{dp}{p}$$

$$= -RT \ln p_2/p_1$$

$$-W = (.729 \text{ cu. ft.-atm./lb.-mole°R})(560°\text{R})\left(2.303 \log \frac{264.7}{14.7}\right)$$

$$-W = (0.729)(560)\ (2.303 \log 18.05)$$

$$-W = (0.729)(560)\ (2.303)\ (1.256) = 1118 \text{ cu. ft.-atm./lb.-mole}$$

$$-W = (1000/16)\ (1118)\ (2116)$$

$$= 155{,}500{,}000 \text{ ft.-lb. } (78.5 \text{ Hp} - \text{hr.})$$

Solution (b) *Adiabatic non-flow compression*—Since the work can be calculated only for the reversible process this is a reversible-adiabatic process and, therefore is an isentropic process. For the non-flow process $dW = pdV$, and for the *isentropic* non-flow process $dS = 0$. The relationship $dU = TdS - pdV$ involves both terms and $dU = -pdV$. Therefore, $dW = pdV = -dU$ and

$$W = \int pdV = -\int dU = -\Delta U$$

$$\Delta U = \int C_v\,dT = C_{vm}\,(T_2 - T_1)$$

$$= (C_{pm} - R)\ (T_2 - T_1)$$

$$-W = (C_{pm} - R)\ (T_2 - T_1)$$

To solve this equation we need to find the final temperature. Since the process is isentropic $\Delta S = 0$.

Therefore, (since $\Delta S = C_{pm} \ln T_2 / T_1 - R \ln p_2 / p_1$)

$$C_{pm} \ln T_2/T_1 - R \ln p_2/p_1 = 0$$

$$R \ln p_2/p_1 = (0.729)\ (2.303 \log. 264.7/14.7)$$

$$= 0.729\ (2.303) \log. 18.05$$

$$= 0.729\ (2.303)\ (1.256)$$

$$= 2.11 \text{ cu. ft.-atm./lb.-mole-°R.}$$

$$C_{pm} \ln T_2/T_1 = 2.11 \text{ cu. ft.-atm./lb.-mole-°R}$$

$$= 5.74 \text{ Btu./lb.-mole-°R}$$

$$\log T_2/T_1 = (5.74)/2.303\,C_{pm} = 2.50/C_{pm}$$

The value of C_{pm} to be used is the mean value between T_1 and T_2. Since T_2 is not known the value of T_2 is determined by trial and error. However, since C_{pm} varies but slightly with temperature not many trials are required.

T_2 (assumed)	C_{pm}	$2.50/C_{pm} = \log T_2/T_1$	T_2/T_1	T_2 °K	T_2 °F
200° F	9.0	0.278	1.890	1,060	600
600° F	10.2	0.245	1.750	980	520
520° F	10.1	0.248	1.77	990	530
530° F	10.1	0.248	1.77	990	530

Therefore $T_2 = 530$°F.

Now that the final temperature is known the work may be evaluated

$$-W = (10.1 - 1.99)\ (530 - 100)$$

$$-W = (8.1) \text{ Btu./lb. mole-°R } (430)°\text{R} = 3490 \text{ Btu./lb. mole}$$

$$-W = 3490\ (778) = 2{,}710{,}000 \text{ ft. lb./lb. mole}$$

$$-W = 2{,}710{,}000(1000/16) = 169{,}500{,}000 \text{ ft.-lb.}$$

$$-W = 85.5 \text{ Hp-hr.}$$

$-W$ = work done *on* the system

Solution (c) *Isothermal flow compression*—For the flow (or cyclic) process $dW = -Vdp$

$$-W = \int_{p_1}^{p_2} Vdp$$

and for the ideal gas

$$\int_{p_1}^{p_2} Vdp = RT \ln p_2/p_1$$

Work in this case is the same as in part (a). For the ideal gas the value for flow and non-flow work are the same. This may be readily observed also from the ideal gas equation $pV = RT$ and at isothermal conditions

$pdV + Vdp = 0$ and $pdV = -Vdp$.

Hence $\int pdV = -\int Vdp$.

Solution (d) *Adiabatic flow compression*—Here the expression for work is $-W = Vdp$ and in the process, $dS = O$ (adiabatic and reversible).

Both of these expressions appear in the same equation in the differential enthalpy equation $dH = TdS - Vdp$.

Therefore, $dH = -Vdp$ and $-dW = dH$

$$-W = \Delta H = C_{pm}\,(T_2 - T_1).$$

As in part (b) it will be necessary to determine T_2 in order to evaluate ΔH. The expression for entropy change will again be used

$$\Delta S = C_{pm} \ln T_2/T_1 - R \ln P_2/P_1 = 0$$

or

$$C_{pm} \ln T_2/T_1 = R \ln P_2/P_1$$

Since the values of p_1 and p_2 are the same as in part (b), the final temperature must be the same and,

$$T_2 = 530\ °\text{F}$$

$$-W = C_{pm}\,(T_2 - T_1)$$

$$= (10.1)\ (430) = 4340 \text{ Btu./lb.-mole}$$

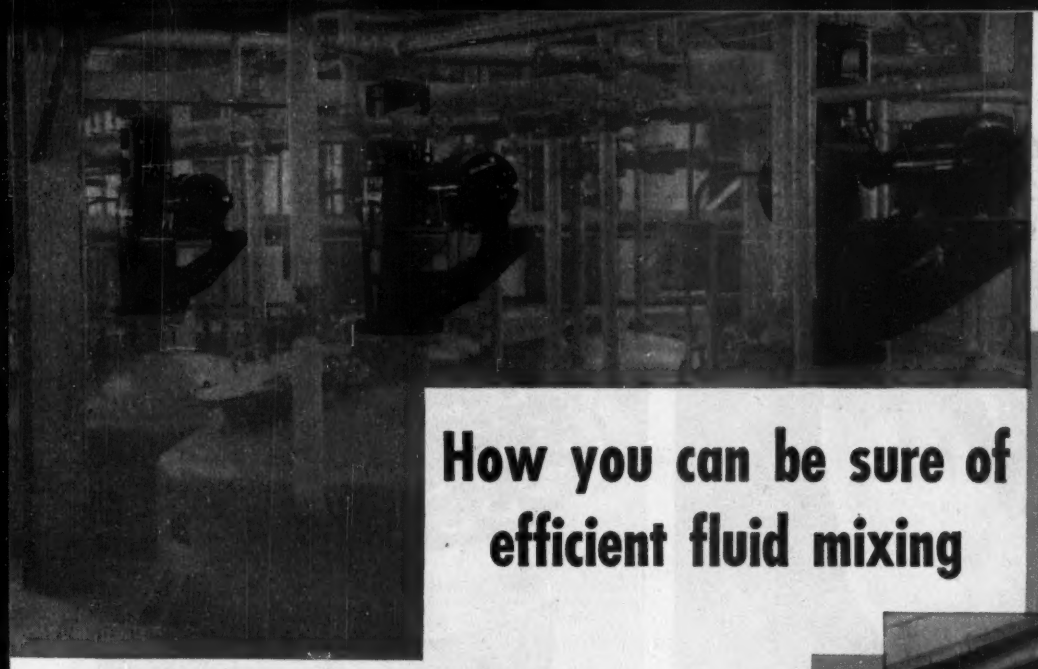
$$= 3{,}380{,}000 \text{ ft.-lb./lb.-mole}$$

For 1000 pounds of gas

1000/16 (3,380,000) = 211,000,000 ft.-lb. or 106.8 hp-hr.

This indicates that more work is required for the continuous process than for the hypothetical single stroke compression even though the final temperature and pressure are the same in both cases. The flow process is the one that can be actually carried out in practice.

Next Month—Compression and Expansion—II will discuss the polytropic process, the use of enthalpy-temperature and enthalpy-entropy diagrams to calculate work and expansion processes. Joule-Thomson expansions and coefficients will get some attention as well as inversion points.



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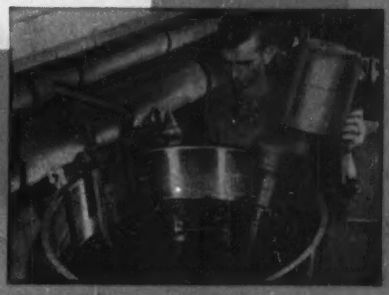

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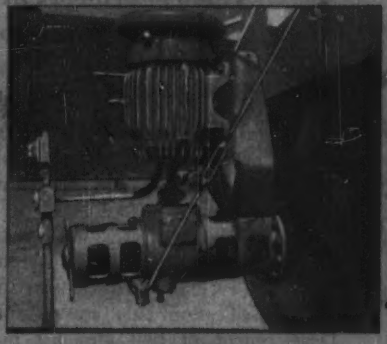

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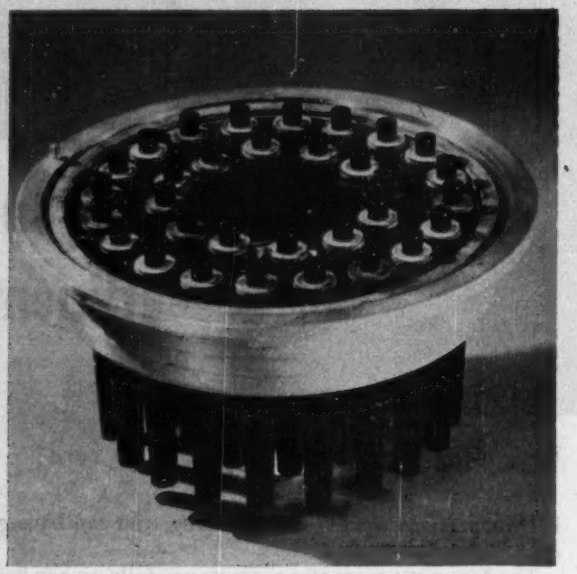

Take a Second Look . . .

These Are Production Cyclones

These newcomers to the liquid cyclone field are truly infant prodigies. Clusters of individual cyclones, operating in nests, classify solids in the 2 to 20 micron range.

It's hard to believe, yet true. These mighty mites are outdoing their big brothers on settling and classifying fine solid particles.

They're the outgrowth of a basic research discovery—as the diameter of a liquid cyclone decreases, finer and finer classification cuts are possible. Development of that idea has produced the multiple unit, type TM DorrClone. Individually the tiny units do a better job—harness enough of them together and you can handle production throughput rates.

▶ **What They Do**—Backers of the type TM DorrClone lay some substantial performance claims. For instance, in many cases, use of these units is said to eliminate the need for a costly centrifuge station. They will produce operating results comparable to a centrifuge. And they offer simpler operation, control and greater flexibility. Also, for any given capacity, the DorrClone installation should be much lower in initial, operating and maintenance costs.

Clarification, classification and thickening are the jobs where this DorrClone shines. Dirty filtrates can be cleaned up. Starch, clays, pharmaceuticals, fillers, pigments, talc, grinding compounds etc. can be sized in the micron range. And in cases where absolutely clear overflows are not required dilute suspensions can be thickened.

Some specific examples have been cited. At a large starch producing plant, four type TM-3 DorrClones have been clarifying filtrate since August 1952. Solids content in the feed to the DorrClones varies between 200 and 1,500 grains per gal. Clarified filtrate must contain less than 50 gr. per gal.

On a typical test run filtrate containing 1,140 gr. per gal. was fed to the DorrClones at a pressure of 113 psi. and a flow of 24 gpm. Overflow was discharged at 20.8 gpm. containing 27.6 gr. per gal. The proportion of total feed solids recovered as solids in the underflow was 97.5 percent.

Classification tests on a true clay suspension produced some interesting results. The feed contained all minus 20 micron particles. It was necessary to make a 95 to 98 percent minus 2 micron split, at maximum solids concentration.

A 16 percent solids slurry was fed to the DorrClones at 26.9 gpm. and 113 psi. Underflow was discharged at 7.7 gpm. It contained 28.1 percent solids with 67 percent of these solids in the plus 2 micron size range. Overflow discharged at 19.2 gpm. containing 10.8 percent solids. These solids were 0.5 percent plus 3 microns and 9.0 percent plus 2 microns.

▶ **They Work As Team**—Individual cyclone elements in the type TM DorrClone have proportions essentially identical to the larger 3 to 24 in. DorrClones. However, the extremely small diameter of the midgets dictate the nesting of a number of the elements in a common housing. All elements in a single housing are connected to common feed, overflow, and underflow chambers.

At present the cyclone components

Equipment Cost Indexes

(Marshall & Stevens Indexes, 1926 = 100)

Industry	Sept. 1952	June 1953	Sept. 1953
Average of all.....	180.5	181.9	182.6
Process Industries			
Cement mfg.....	172.7	173.6	174.3
Chemical	181.1	182.0	182.7
Clay products	167.7	168.5	169.2
Glass mfg.....	171.1	172.0	172.7
Paint mfg.....	174.4	175.3	176.0
Paper mfg.....	174.7	175.6	176.3
Petroleum ind.....	177.8	178.7	179.4
Rubber ind.....	180.2	181.1	181.8
Process ind. avg....	178.6	179.5	180.2
Related Industries			
Elec. power equip...	183.0	183.9	184.6
Mining, milling	182.1	183.0	183.7
Refrigerating	200.9	202.2	203.1
Steam power	170.7	171.6	172.3

Compiled quarterly for March, June, September and December of each year by Marshall and Stevens, evaluation engineers, Chicago and Los Angeles. Indexes are prepared for 47 different industries, from which the eight process and four related industries listed here are selected. Published each month with the latest available revision. For a description of the method of obtaining the index numbers see R. W. Stevens, **Chemical Engineering**, Nov. 1947, pp. 124-6. For a listing of annual averages since 1913 see **Chemical Engineering**, March 1953, pp. 220, 221.

of a TM DorrClone are constructed either of rubber or bakelite. When rubber is used, 24 cyclone voids with 15 mm. inside diameters are cast in a single block. Bakelite cyclone components are individually molded to an inside diameter of 10 mm.

Bakelite cyclones in groups of 32 are nested in a bronze or stainless steel holder. Both the rubber block unit and the bakelite assembly are enclosed in identical housings.

Each small cyclone element operates exactly as the large single units. Feed under pressure is introduced tangentially into the upper cylindrical section.

Relatively coarse material is thrown outward to the cone walls. As it collects it passes downward and out through the underflow opening.

Fine particles move inward. Together with most of the water they pass upward and out through the overflow opening.

Multiple unit, type TM DorrClones may be arranged in one, two or three stage assemblies—designated TM-1, TM-2 and TM-3 respectively.

All cyclones in each stage operate in parallel—stages are connected in series. First stage overflow feeds the second stage; overflow from the second stage feeds the third stage and third stage overflow is the final effluent.

Only underflow from the first stage is removed from the system. Other underflows are recycled to the feed.

▶**Easy Control**—Units are controlled either manually or automatically by regulating backpressure on the underflow manifold of each stage. Increased backpressure raises the density of underflow discharge and decreases the volume ratio (underflow volume rate divided by feed volume rate).

Recovery of solids in each stage is a function of both the feed dilution and the volume ratio. Increasing the ratio increases recovery of solids to the underflow. At a given feed dilution there is one volume ratio that

IN BRIEF—A capsulated listing of this month's newsworthy equipment.

New Processing Equipment		Page
Liquid Cyclones	In miniature size give finer separations	218
Impact Crusher	Provides closed circuit screening within unit	220
Small Process Filter	Removes pyrogens and bacteria with asbestos sheets	220
Giant Water Softener	Has unique design for more effective operation	220
Water Sterilizer	For high flow uses ultraviolet ray radiation	220
Horizontal Rotary Filter	Eliminates costly foundation with built-in drive	220
New Packaging & Handling Equipment		
Reinforced Plastic Tray	For freezing and dehydrating, stacks at angle	222
Rotary Air-Lock Feeder	Feeds solids into pressure or vacuum systems	222
Double-Wall Drum Liner	Of polyethylene gives added protection	222
Industrial Scales	Offer increased precision and wider range	222
Magnetic Pulley	For belt conveyors is smaller and stronger	222
Air Transport	Speeds critical centrifuge shipment across country	222
New Materials of Construction		
Rigid Plastic	Made of unplasticized PVC offered in sheets, plates	224
Non-Skid Grills	Of lightweight construction give firm footing	224
Industrial Flooring	Contains heat conductors, withstands heat	224
Hard Vinyl Nameplates	Assure continuous identification despite corrosives	224
Jacketed Wire Cable	Has colored nylon covering for long life	224
Hard Surfacing Alloy	Is applied with metallizing gun, fused with torch	224
Radiation Shielding Alloy	Has no lead, contains tungsten, nickel, copper	224
Water Tank Lining	Applied by trowel gives non-porous insoluble liner	224
LPG Tank Insulation	Applied with cement gun protects tank from fire	224
New Fluids Handling Equipment		
Pump	For corrosives uses heat as source of energy	226
Chemically Resistant Crocks	In 5 to 125 gal. size are made of plastic laminate	226
Lubricated Plug Valves	Recently added to well known line of valves	226
Controlled Volume Pump	Can be operated fully submerged in corrosives	226
Corrosives Pump	Has an impeller of Hypalon chlorinated polyethylene	226
Gate Valve	Gives tight seal without freezing or sticking	228
Controlled Volume Pump	Covers wide range of flow and pressure conditions	228
Wet Dust Collector	Uses S-shaped water curtain to separate dust	230
Pneumatic Control Valve	Features new topworks design and split valve body	230
Portable Laboratory Mixer	In explosion-proof construction mixes up to 50 gal.	231
Portable Propeller Mixers	In sizes from ⅛ to 3 hp. and choice of construction	231
Bronze Pump	Handles continuous recirculation of water	231
Rotary Pumps	Now available in two new models for 70 to 226 gpm	231
Needle and Globe Valves	Made in sizes from ⅛ to 2 in. of rigid PVC	231
New Electrical & Mechanical Equipment		
Electric Motor	Completely redesigned to meet new NEMA standards	232
Powder Lance	Uses metallic powder and oxygen to cut and pierce	232
Non-Depositing Electrode	Acts as heat source for preheating and annealing	232
Miniature Metallic Seals	Are made of ¼ in. dia. stainless steel tubing	232
Fluorescent Lights	Are made with explosion-proof construction	232
Conduit Bender	Permits installation of conduit without elbows	232
Condenser Tube Cleaner	Shoots nylon brushes through fouled tubes	234
Oil Sight Glass	Made of Kel-F plastic withstands shock, corrosion	234
Battery Cell Puller	Eases job of replacing or repairing faulty cells	235
Oiling System	Delivers fine oil mist to bearings continuously	235
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D. C. Arc Welder	Is easier to operate, smaller and lighter	236
Packing Compound	Consists of copper flakes dispersed in stick form	236
Portable Tester	For circuit breakers has built-in ammeter	236
Degreaser	Uses trichlorethylene vapors to clean oily parts	236
Gearmotors	Now available in 1 to 15 hp. and choice of gears	236
New Instruments & Controls		
Pressure Cells	Use strain gages to give high frequency response	238
Vibration Relay	Guards heavy rotating parts from excessive vibration	238
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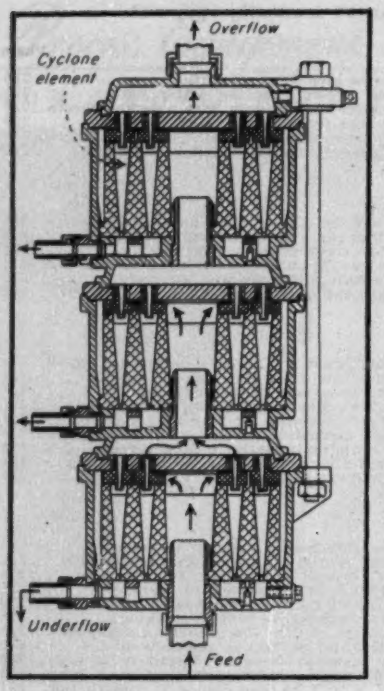
Pneumatic Transmitter	For controlling flow is actuated by rotameter	238
Instrument Tubing Cable	Saves money on long multiple runs of tubing	238
Mass Spectrometer	Operates continuously on ion resonance principle	238
Kilovoltmeter	Indicates voltage and percent voltage variation	240
Electronic Controllers	Are adaptable to a wide range of control problems	240
Recording Turbidimeter	Actuates alarm as well as measuring turbidity	241
Pneumatic Controller	In miniature size incorporates 3 modes of control	241
Flame Failure Control	Combines safeguarding with programming control	242
Temperature Control	Covers 3 ranges from −100 to 600 deg. F	242
Portable Smokescope	Gives precise indication of density of effluent	242
Electronic Level Control	Holds level within ¼ in. by capacitance change	242
Dust Measuring Instruments	Furnished in 4 models for various sampling jobs	242
New Heating & Cooling Equipment		
Air Conditioning Unit	Combines conditioner and absorbent reconcentrator	244
Packaged Steam Generator	Has 2 pass design, eliminates baffles and partitions	244
Tube Furnace	Reaches maximum temperature of 5,000 F in 2 hr	245
Anthracite Burner	Boosts output of steam and hot water 15 percent	245
Packaged Boiler	Is smallest 50 hp. fire-tube boiler available	246
Steam Valve	Will not stick from expansion or scale deposits	246



THREE STAGE DorrClone assembly, rubber block type.

gives optimum solids recovery to the underflow—and another volume ratio that produces maximum underflow density.

Normally a multiple unit, type TM DorrClone is set for maximum underflow density in the first stage. Succeeding stages are run for optimum solids recovery to the underflow. This procedure can be changed to meet specific process requirements.—*The Dorr Co., Barry Place, Stamford, Conn.*

Impact Crusher Includes Closed Circuit

For crushing to 10 mesh the Bradmill offers the combination of impact crushing and closed circuit screening in one unit. This saves the expense and space normally required for closed circuit equipment.

Crusher has two rotating elements enclosed in a dust tight housing. The high-speed, 200 to 1,500 rpm., inner element is a shaft fitted with paddle hammers. The outer, slow-speed, 15 to 30 rpm., element is a screen drum with either a screening cloth or a perforated plate.

Material to be crushed is fed into the revolving screen drum. Within the drum spaced equally around the circumference are radial lifting plates set at right angles to the screen. Material is carried by the shelves to a point near the top of the rotor. It then slides freely into the path of the impact blades.

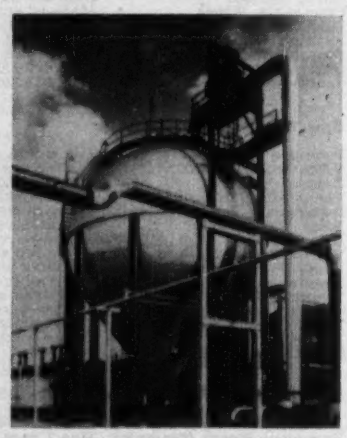
Solids crushed to final size are passed through the drum screen. Oversize stays in the drum and is returned once more to the impact point.

When screen cloth is used it is necessary to provide deflecting plates to protect the cloth from damage by flying particles. If perforated plates are used on the drum the deflecting plates are not needed.—*Pennsylvania Crusher Co., Liberty Trust Bldg., Broad & Arch Sts., Philadelphia, Pa.*

Small Process Filter For Pyrogens and Bacteria

Using asbestos filter sheets model 8-ESS filter effectively removes pyrogens and bacteria. Also it is said to be useful for filtration of perfumes, essential oils, drugs, pharmaceuticals and chemicals.

Filter is available in highly polished stainless steel, Lucite and stainless steel, or all Lucite construction. When liquid temperatures are below 120 deg. F. and where sterilization is not required Lucite offers the advantage of visual inspection during filtration.—*Ertel Engineering Corp., 90 Front St., Kingston, N. Y.*



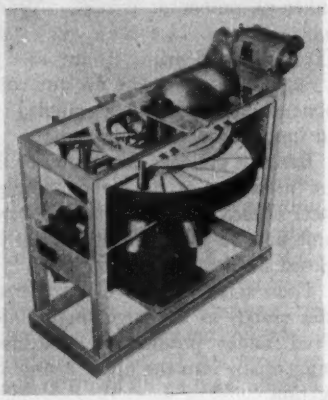
GIANT WATER SOFTENER

.....Unique design of this Spherlcone water softener is said to give distinct advantages in obtaining clearer and softer water. Said to be the world's largest hot zeolite unit, it handles 200,000 gph. of feedwater for 650 psi. boilers. Unit is installed at Bayway Refinery of the Esso Standard Oil Co.—Graver Tank & Mfg. Co., 424 Madison Ave., New York 17, N. Y.

Ultraviolet Sterilizer Cuts Sterile Water Cost

Water sterilization on a large scale now can be done at low cost. Chlorination, heating and cooling, and tank storage can be eliminated. Bacterial contamination is killed by powerful ultraviolet rays.

Unit can process up to 7,000 gph. It weighs only 95 lb. and operates on 110-v., 60 cycle a.c. power. Life of the ultraviolet lamps is 6,000 hr. Stainless steel sterilizer is designed for ease of maintenance and lamp replacement.—*Aquafine Co., 1005 South Santa Fe Ave., Los Angeles 21, Calif.*



Horizontal Rotary Filter Uses Built-In Drive

Costly foundations have been eliminated in the new Feinc horizontal rotary vacuum filter. Reason is that the self-contained driving unit is mounted in the main frame.

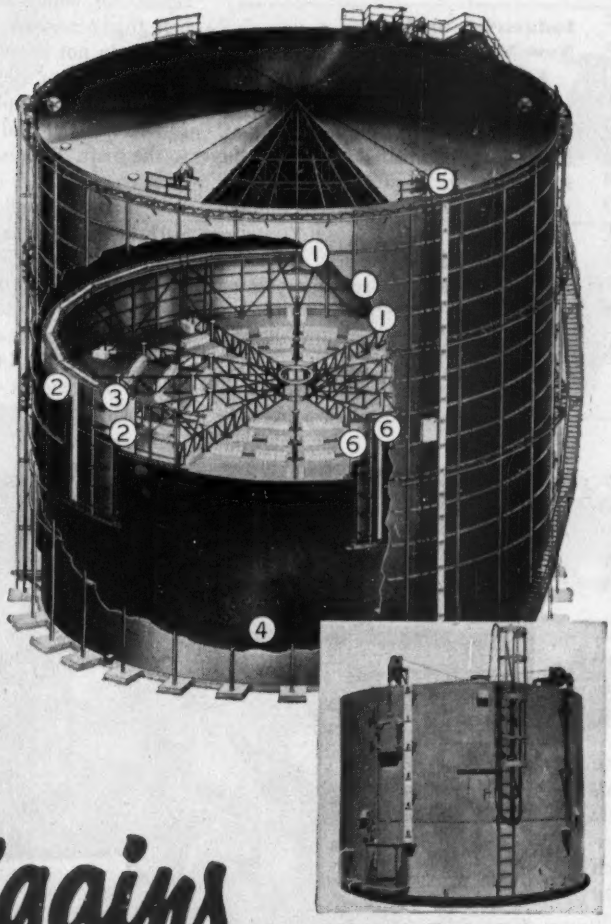
Filter is said to offer high efficiency on coarse crystalline materials, fibrous pulps and other free-filtering substances. It consists of a revolving pan with cloth- or screen-covered wedge-shaped filter sections in the bottom. A valve connected to each section controls dewatering, washing and discharging operations as the table rotates. Finished cake is removed by a revolving scroll and dropped into a chute or conveyor.

Compactness of the filter readily permits totally enclosed construction. Sizes range from 7.6 sq. ft. to 110 sq. ft.—*Filtration Engineers, Inc., 155 Oraton St., Newark 5, N. J.*

no. 3 *of a series*

GUIDES TO GASHOLDER PLANNING

"Diffusion is bad news in gas storage.
Before we buy we've got to know . . .



1 Top section of shell completely ventilated

2 Wide clearances simplify operation

3 Gas-tight friction-less seal not affected by weather

4 Piston rests on bottom—less than ½ of 1% for purging

5 Leveling device—independent of side-wall—keeps piston level

6 Fenders prevent all tension in seal

5,000 cu. ft. Wiggins Gasholder for storing tetrafluor-ethylene

How gas-tight is the seal?"

Helium and tetrafluor-ethylene have characteristics which present a special storage problem. Helium must be stored under conditions which will not permit contamination by even the slightest diffusion of atmospheric air through the seal of its gasholder. Tetrafluor-ethylene is an expensive gas and any escape by diffusion can represent a considerable dollar loss.

Wiggins Gasholders have seals which retain each of these widely different gases without contamination or economic loss. The patented Wiggins dry fabric seal gives air-tight protection against contamination to helium . . . and gas-tight protection from diffusion loss to tetrafluor-ethylene. In installations throughout the country, with all types of gas products, the Wiggins Gasholder with its impermeable *dry* seal has proved itself in years of trouble-free performance.

Wiggins Gasholder

WIGGINS VAPOR SEALS GENERAL AMERICAN TRADE MARK

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Reinforced Plastic Tray Can Be Stacked and Locked

A new fibrous glass reinforced plastic tray is said to be ideally suited for freezing, dehydrating, and other food, chemical and pharmaceutical material-handling operations.

Tray has stacking lugs on four sides, permitting stack of trays to be held at 45-deg. angle without danger of toppling. Tray obviates necessity for racks as the sides are open, permitting air passage through them.

Tray is dimensionally stable from −60 to +300 deg. F. It is unaffected by most chemicals and alkalies.—*Molded Fiberglas Tray Co., Linesville, Pa.*

Rotary Solids Feeder for Pressure or Vacuum

Bulk feeding of solids under high pressure or vacuum is done effectively with a new rotary-feeder air lock. Applicable to chemical and food processing, feeder is available in cast iron, stainless steel, or monel.

Application on high-pressure systems is possible because of effective sealing of rotor ends. This is accomplished with a sealing member supplemented by inert gas.

Rotor is furnished with six or more pockets. Vanves are hard surfaced, ground, and polished to extremely close tolerance. Casing ends are fastened with only four bolts, which facilitates ease of dismantling for cleaning.—*Beaumont-Birch Co., Philadelphia, Pa.*

Double-Wall Drum Liner Provides Air Cushion

An easier ride and added protection for drum contents can be provided with a new double-wall polyethylene drum liner. Enclosed between the liner walls is an insulating and cushioning air space.

Transparent double wall increases the strength of the liner and distributes shocks and pressure. This greatly lessens possibility of tearing, providing added protection to the contents.

Liner is suitable for liquid or solid materials. It can be used for transporting acids, alkalis, foods and other hard-to-handle products.

Liners are available with either 0.015 or 0.02 mil polyethylene. They are furnished with flat bottoms for 15, 30 and 55 gal. drum sizes.—*Mehl Mfg. Co., Div. of Sydney-Thomas Corp., Cincinnati 2, Ohio.*

Industrial Scales Now More Precise, Stronger

A new line of industrial scales offer increased precision and strength. Hand adjustments, formerly needed, have been eliminated. Key to the improvements lies in the design of the full-floating, double-pendulum mechanism.

Indicating heads of these new scales can be installed to face in any one of eight different directions; or they can be furnished to swivel fully through 360 deg.

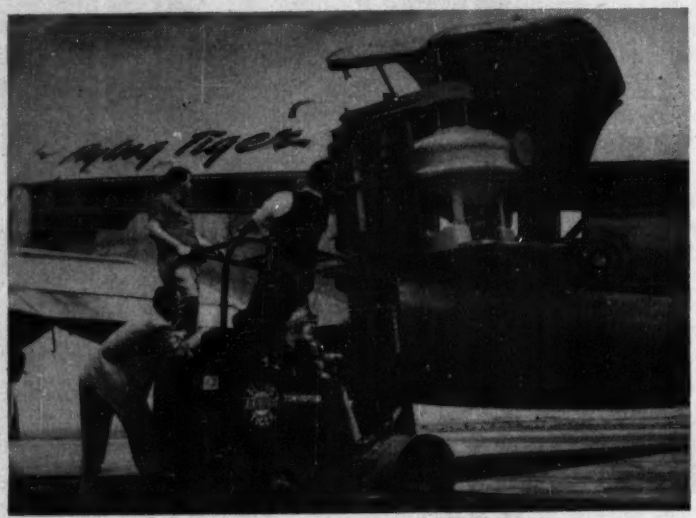
In the portable model, over-all dimensions of the base have been reduced yet the platform is 18 percent larger. Heavy capacity models now have up to 9 unit weights available in standard combinations. Thus a single scale can handle a wider load range while maintaining uniform accuracy.—*Toledo Scale Co., Telegraph Rd., Toledo, Ohio*

Small Magnetic Pulley Has Beefed-Up Strength

A new 4-in. dia. permanent magnetic pulley is said to test as strong as units twice its size. Pulley is designed for conveying systems where belt thicknesses are ⅛ in. or less and speeds do not exceed 30 rpm.

Pulley has a peripheral magnetic field running completely around the surface parallel and circumferentially to the shaft. Because of the proximity of magnet castings and pole plates to the shaft, all pulleys are furnished with heavy, non-magnetic, 1-in. stainless steel shafts. The pulleys themselves also can be supplied in stainless steel.

Flat-face construction is standard in 4, 8, 10, 12, 14, 16, 18, 20 and 24 in. belt widths.—*Eriez Mfg. Co., Erie, Pa.*



GROUND CONTROLLED APPROACH FOR LOADING

Even with the top portion dismantled it was a tight squeeze to fit this 6½ ton, $45,000 nozzle-type centrifuge through the loading port of a C-46. Loaded at San Francisco, machine was flown to Tampa, Fla. for delivery to Bonnie Chemical Plant of the International Minerals & Chemical Corp., Bartow, Fla. Plant processes phosphate ore for production of fertilizer and high quality poultry feed supplement. Uranium is recovered as byproduct. Supplementing rotary drum filters, Merco C-30 centrifuge removes small precipitated fluoride particles to reduce fluorine content of the process stream.–Merco Centrifugal Co., San Francisco, Calif.

which OF THESE MATERIALS IS BEST FOR *your* CORROSION PROBLEMS?

• ACE HARD RUBBER PIPE AND FITTINGS

Two types: (1) All hard rubber, threaded pipe for service to 50 psi., 120° F. (2) Rubber-lined steel, flanged pipe for pressures to 125 or 250 psi. Have same fine chemical resistance as tank linings.

• ACE SARAN

Saran pipe, tubing, fittings, diaphragm valves, special molded parts, etc., have unusual resistance to chemical attack at room temperature. Dimensionally stable. High strength.

• ACE HARD RUBBER LININGS

Economical, universal protection against all alkalies, metallic salts, practically all inorganic acids, hydrochloric acid any strength, sulphuric to 50%, nitric to 20%, phosphoric to 75%. Good to 160° F. — sometimes higher. Ask for details of Ace two-layer lining system.

• ACE PARIAN

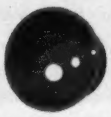
Slightly better resistance at room temperature to moisture and chemicals (except acetic acid) than Saran. High impact strength. Odorless, tasteless, non-toxic, good for handling foods. At left: Parian diaphragm valve.

• ACE SOFT RUBBER LININGS

Corrosion resistance near that of hard rubber . . . recommended where abrasion, mechanical abuse, or temperature variations are problems. At left is 12,000 gal. outdoor acid storage tank, lined with soft rubber.

• ACE-HIDE

New resin-rubber blend combines unusually high impact strength and toughness with light weight and good chemical resistance. Available in molded parts. At left is standard 3-gal. Ace-Hide acid pail.



• ACE SYNTHETIC RUBBER LININGS

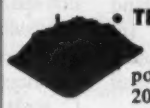
Many types available for handling oils, gasoline, other organic corrosives. Often used for higher heat resistance. Evaporator head at left, for instance, works at 212° F.

• ACE-TEX

Low cost pyrobituminous molding compound has excellent resistance to strong alkalies, calcium chloride, hypo, sulphuric acid to 1.30, etc., but poor resistance to organic solvents and oils. Good for small tanks, etc.

• ACE MOLDED HARD RUBBER PARTS

Many parts can be produced most economically by molding. This chlorine gas cell cover is example. Many large shapes can also be fabricated by special hand-wrapping process.



• TEMPRON

New heat-resistant Buna-N compound handles many corrosives to 200° F. and above. At room temperature has better resistance to organic chemicals than natural rubber or plastics. Pipe, fittings, fabricated parts, etc.

With literally hundreds of rubber and plastic compounds to choose from, we can usually supply the one best, most economical material for any corrosion problem. Pumps, tanks, piping, valves, utensils, and special molded or fabricated parts. Ask for our recommendations.

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Rigid Plastic Offered in Sheets and Plates

Complete unplasticized and unmodified polyvinyl chloride is now available in plates and sheets. Thickness of Vyflex PVC plates ranges from ⅛ to 1 in.; sheeting from 0.012 to 0.025 in.

All standard methods of thermoplastic fabrication technique can be used with Vyflex material. In addition, this PVC can be fabricated by hot gas welding. This permits construction of complex units and structures, such as fume exhaust systems, acid tanks, and other equipment exposed to severe corrosive conditions. —*Kaykor Industries, Inc., Yardville, N. J.*

Non-Skid Grills Assure Firm Footing

A new line of non-skid grills assures safe walking and firm footing in grease, oil, snow and sleet. Featuring lightweight design, these grills are adapted to assembly of platforms, catwalks, and stair treads for slippery floor areas and steep inclines. Coroweld non-skid grills are available in various sizes to meet individual installation requirements.—*Bustin Firm-Grip Grating Corp.*

Industrial Flooring Withstands High Temperature

Aluminum-rod heat conductors embedded below the surface enable a new industrial flooring to withstand temperatures up to 2,000 deg. F. Intense heat is dissipated rapidly through the rods over a wide area of the floor.

Other outstanding characteristics are ability to withstand thermal shock and the heaviest type of industrial wearing forces.

Careful selection of rock and sand together with correct formulation and power compaction during installation provide a high density concrete. Floor is ready for use 24 hours after installation. — *Flash-Stone Co., Inc., 3723 Pulaski Ave., Philadelphia, Pa.*

Hard Vinyl Nameplates Remain Intact Permanently

The harassing problem of keeping nameplates and instrument panels intact in corrosive environments is being solved through use of Lucoflex unplasticized PVC. Resistance of the material to the action of most solvents, brine, and other corrosives makes it adaptable as a substitute for metal nameplates. Exhibiting a metal-like machinability, Lucoflex can be fabricated by all the usual processes. Use of Lucoflex screws makes the entire nameplate assembly corrosion-resistant. — *American Lucoflex, Inc., 767 Fifth Ave., New York, N. Y.*

Nylon Jacket Extends Wire Cable Life

Wire cable with a distinctive look and long life has a tight-fitting colored nylon jacket. Jacket is formed by extruding nylon around a core of wire cable. It increases cable life up to 500 percent, is smooth and safe to handle, and withstands abrasion, kinking and corrosion.

Originally Wirelon cable was made with a colorless jacket. Now with the color it is more easily identified.—*Rochester Ropes, Culpeper, Va.*

Metallizing Gun Applies Hard Surfacing

A one-two punch leveled at wear surfaces is said to give greatly increased service life. Metco-Weld H alloy, a chromium boride, is being applied with a metallizing gun, then fused with an acetylene torch. The resultant surface is said to outwear hardened steels by 3 to 10 times; is non-sparking, non-magnetic and has a low coefficient of friction.

Deposits of Metco-Weld H have a hardness of 56 to 61 on the Rockwell C scale. Used on oil refinery acid sludge pumps the alloy increased rod life from 24 to over 500 hr. Long agitator shafts running in stuffing boxes at two points now are protected by this alloy from the date of installation.—*Metallizing Engineering Co., 38-14 30th St., Long Island City 1, N. Y.*

Non-Lead Alloy Is Good Radiation Shield

A non-lead alloy, Mallory 1000, is especially suited for use as an efficient radiation shielding material. Metal is a high density homogeneous alloy of tungsten, nickel and copper.

All tests to date indicate this alloy to be suitable for use in containers for radioactive isotopes storage. In addition, the metal is a good shielding material for betatron, synchrotron and cyclotron radiation. It is strong and machinable and can be joined to itself or to other metals by any of several techniques.—*P. R. Mallory & Co., Inc., 3029 East Washington St., Indianapolis 6, Ind.*

Water Tank Lining Prevents Corrosion

Both new and old hot water generators and storage tanks can be protected from corrosion with Plasticote tank lining. Applied by trowel, to a thickness of ⅛ in., this material gives a non-porous, insoluble coating.

Once the lining is applied maintenance costs are said to be eliminated. Annual cleaning, painting and scraping are no longer required. Lining also provides extra insulation reducing heat loss and solves the rusty water problem.—*Metalweld, Inc., Scotts Lane & Abbottsford Ave., Philadelphia 29, Pa.*

Refractory Insulation Guards LPG Tanks From Fire

Above ground propane and butane storage tanks now can be effectively insulated against fire. A lightweight insulation, K-20 concrete mix, applied with a cement gun furnishes the desired protection.

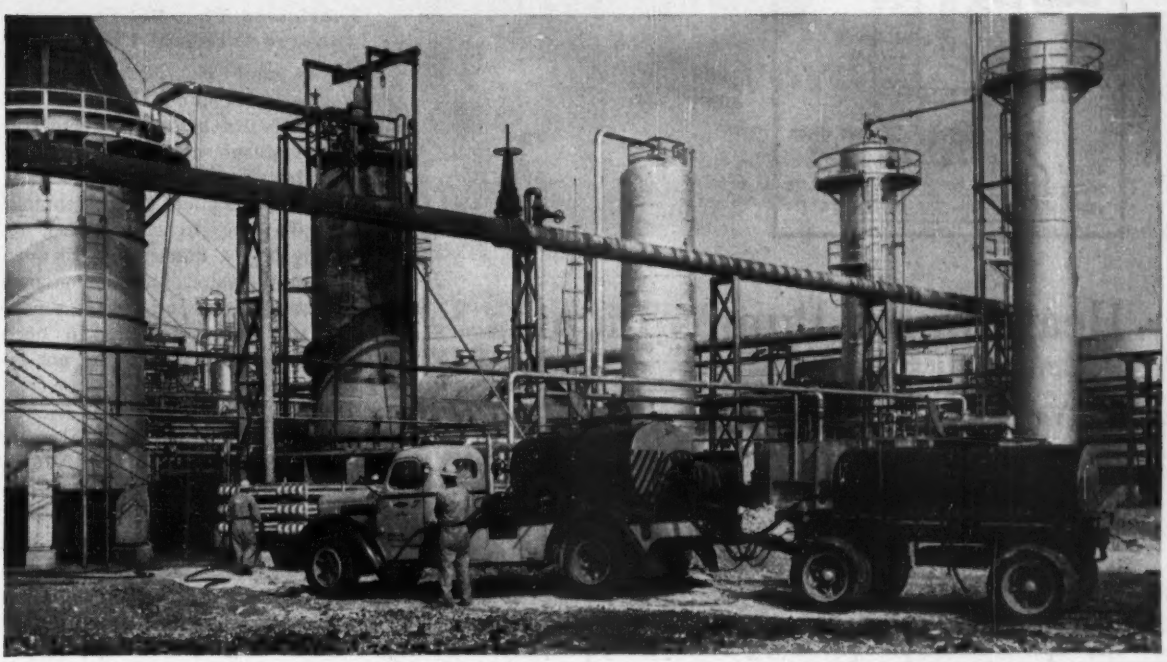
Prior to application the tank is covered with a corrosion-resistant paint. Steel car-banding straps then are tightened around the tank at 2 ft. intervals. To these are fastened bent clips spaced 12 in. apart. Finally, 2-in. galvanized-steel, wire-mesh reinforcement is attached to the clips.

Insulating material is applied to a thickness of 1½ in. After the Kaolin base cement has thoroughly dried it is sprayed with a waterproof coating to provide a good water-vapor seal.

Under test exposure of 1,800 deg. F for 2 hr. steel plate protected by this insulation did not exceed 400 deg. F. The safe limit for the shell of an LPG tank under fire exposure is considered to be 800 deg. F. Application of a hose stream to the hot insulation failed to destroy its effectiveness.—*The Babcock & Wilcox Co., Refractories Div., 161 East 42nd St., New York 17, N. Y.*

5-MILE LPG LINE CLEANED BY DOWELL IN 12 HOURS

Chemical cleaning restored 200 pounds of pressure lost through scale-choked butane line



A pressure drop of about 200 pounds, due to scale accumulation in a butane line, was increasing pumping costs. The 2½-inch buried line carries butane from a refinery to a butadiene plant five miles away. Dowell Service cleaned the line in 12 hours—*without dismantling or digging*. The results: original discharge pressure was restored . . . the line was metal-clean . . . the workload on equipment handling the butane was lessened, netting the operator a considerable saving.

Dowell engineers took specially prepared solvents in truck-mounted tanks right to the job. They applied the chemicals through regular connections using Dowell-designed equipment, which includes all necessary pumps and control devices.

This is but one example. There are countless others where Dowell provided the practical solution to tricky maintenance cleaning problems. Dowell Service is designed to clean process lines, heat exchangers, tanks and many other pieces of industrial equipment. No special scaffolding is required. Dismantling and downtime are kept to a minimum.

Solvents are applied by Dowell engineers according to the techniques demanded by the job—jetting, filling, spraying, cascading or vaporizing. These liquid chemicals go wherever steam and water flow, reaching surfaces inaccessible to other methods.

You can discuss your cleaning problems fully, simply by calling a Dowell engineer. He will be happy to make cost estimates—no obligation, of course. For more facts about Dowell Service, call your nearest Dowell office. Or, if you prefer, write directly to Tulsa, Dept. L-33.

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Over 130 Offices to Serve You with Chemical Cleaning for:

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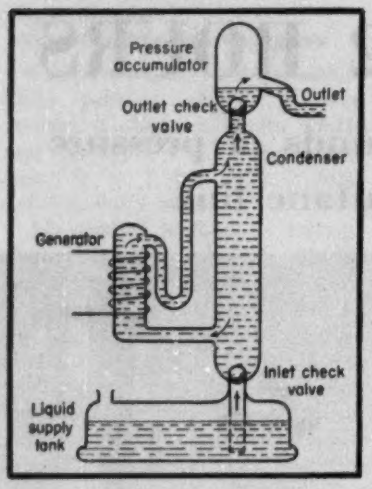

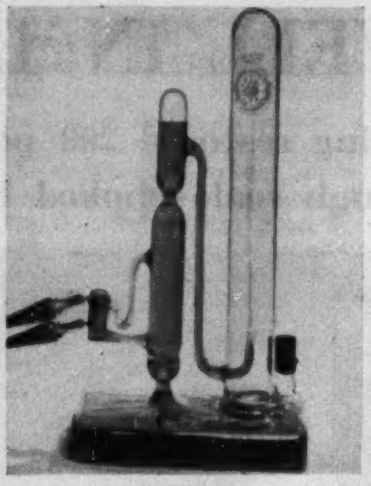

Heat Source Pumps Liquids

New pump uses heat as source of energy for pumping. Vapor pressure expells liquid from pump. Unit is ideal for handling corrosive or dangerous materials.

A fresh look at an old idea sometimes produces a useful development. It was this line of attack that led to the design of the Thermopump.

Movement of fluids by heat-generated vapor is an old principle. It is found in more rudimentary forms in coffee percolators and toy boats. And it has been used in pumping units characterized by limited operating performance.

Now the re-designed and re-engineered Thermopump offers greatly increased pressures and flow rates. It can be made entirely of glass; has no moving parts except check valves. Pump can be hermetically sealed and is ideal for handling corrosive or dangerous materials.

Both initial and operating costs are low. Since there is nothing to wear out, maintenance is virtually nonexistent.

Thermopump is particularly suitable where waste heat is available as power, where silent operation is essential, where electricity or mechanical power are not conveniently available, and where the fluid being pumped is to be heated anyway. Liquids that can be pumped vary widely from water and Freon to oils and mercury.

Because of low efficiency compared to mechanical pumps, the Thermopump is not intended for universal application. Nonetheless, even in small models it pumps up to 8 gph. of fuel oil at pressures to 25 psi.

Fluid being pumped is alternately vaporized and condensed during the pumping cycle. Either flame or electric heat is applied to the vapor generator (see sketch). Vaporization of the fluid builds up pressure to expell the fluid through a check valve.

When the fluid is expelled, a hydrostatic unbalance occurs in the pump, forcing cool fluid into the generator. At the same time condensation of vapor creates a partial vacuum. New fluid is, thereby, pulled from the tank into the pump.

In addition to glass, the Thermopump can be made of metals such as stainless steel or combinations of metal and glass. Where more than one unit is needed, Thermopumps may be hooked up in parallel or series.—*Jet-Heet, Inc., Product Development Div., 152 S. Van Brunt St., Englewood, N. J.*

Chemically Resistant Crocks Made of Plastic Laminate

A line of crocks now available in 5 to 125 gal. capacity are manufactured of Iolyte, a Fiberglas reinforced polyester laminate. These crocks are chemically resistant and cannot break or crack. Crocks are cylindrical in shape without any taper, and are said to be inexpensive. Special sizes are made to order.—Schori Process Div., *Ferro-Co Corp., 8-11 43rd Rd., Long Island City, N. Y.*

Lubricated Plug Valves Augment Suppliers Line

New semi-steel and steel lubricated plug valves round out the Powell line of all types of bronze, iron and corrosion-resistant valves.

Featured in the new lubricated plug valve is a quick and positive shutoff. All valves are wrench operated, requiring only a quarter turn to open or close the valve. Lubricant grooves surrounding each port provide a positive seal during closure. In open position, seating surfaces are not exposed.

Valves are available with screwed or bolted glands. Semi-steel valves are available for 175 and 200 lb. WOG. Carbon steel valves are available for 150 and 300 lb. WP.—*The Wm. Powell Co., 2525 Spring Grove Ave., Cincinnati 22, Ohio.*

Controlled Volume Pump Operates Fully Submerged

One way to stop stuffing box leakage is to submerge the entire pump. That's the step taken in a new variation of a standard controlled volume pump. It simplifies controlled volume pumping of dangerous corrosive fluids.

On the submerged miniPump only the driver and discharge piping are exposed above the liquid level.

Pump has capacities from 3 to 3,200 ml. per hr. at pressures up to 1,000 psi. Capacity regulation can be either manual or automatic.—*Milton Roy Co., 1300 East Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa.*

Added Corrosion Resistance Gained for Pump Impeller

All-Chem pumps now can be furnished with impellers constructed of DuPont's Hypalon, a chlorinated polyethylene polymer.

Hypalon is dimensionally stable up to 160 deg. F.; permits pump operating pressures to 150 psi. Chemically, these impellers are ideal for handling

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Name a product that is being dried commercially and there is a 99% chance it is being done in a Proctor system. The background on which Proctor engineers draw when working on a drying problem covers a longer period of time (70 years)... and a wider range of products than can be found anywhere else in the world.

Only an organization with the breadth and depth of dryer design experience possessed by Proctor engineers can make such a strong claim and make it stick. And there is no organization with this experience other than Proctor & Schwartz.

When you have a drying problem—the easiest and safest approach is to call Proctor engineers early. The sooner you have them working with you—the sooner you'll have your solution and your guarantee that it is the right solution.

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PHOSPHORUS TRICHLORIDE	ALKYL ACID PHOSPHATES (Alkyl Phosphoric Acids)
PHOSPHORUS PENTACHLORIDE	SODIUM CHLORATE
PHOSPHORUS PENTASULFIDE	POTASSIUM CHLORATE
PHOSPHORUS SESQUISULPHIDE	POTASSIUM PERCHLORATE
AMORPHOUS PHOSPHORUS	HYPOPHOSPHITES
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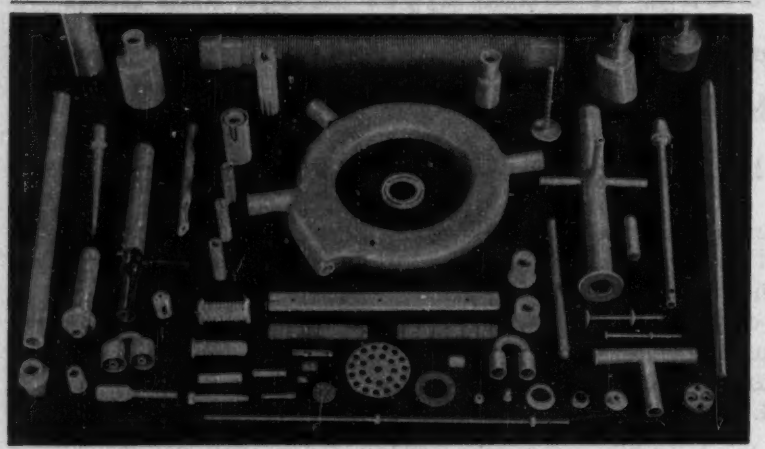

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We are equipped to design and manufacture special porcelain products to do specific jobs. A few of the various shapes and sizes are shown above. On any of your porcelain requirements, a call will save time and money.

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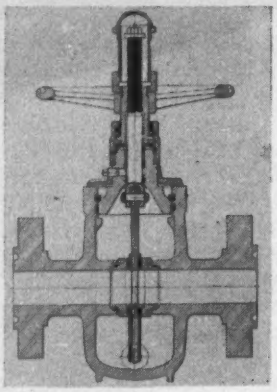
GRINDING BALLS . . . MILL LINING BRICK . . .
MILL HEAD ASSEMBLIES . . . TANK & DRYER LININGS

chlorine dioxide, chromic acid, nitric acid, sodium hypochlorite, stannous chloride, sulfuric acid, pickling and electroplating solutions.

Also these impellers have zero moisture absorption, high immunity to attack by ozone, good flex life and resistance to oxidation and abrasion. —*Eco Engineering Co., 12 New York Ave., Newark, N. J.*



Gate Valve Seal Stops Freezing or Sticking

No wedges, plugs or lubricants are used with the Seal-O-Ring gate valve, yet it is claimed to give a bubble-tight impassable seal. The valve operates without freezing or sticking; it can be moved with ease at all times.

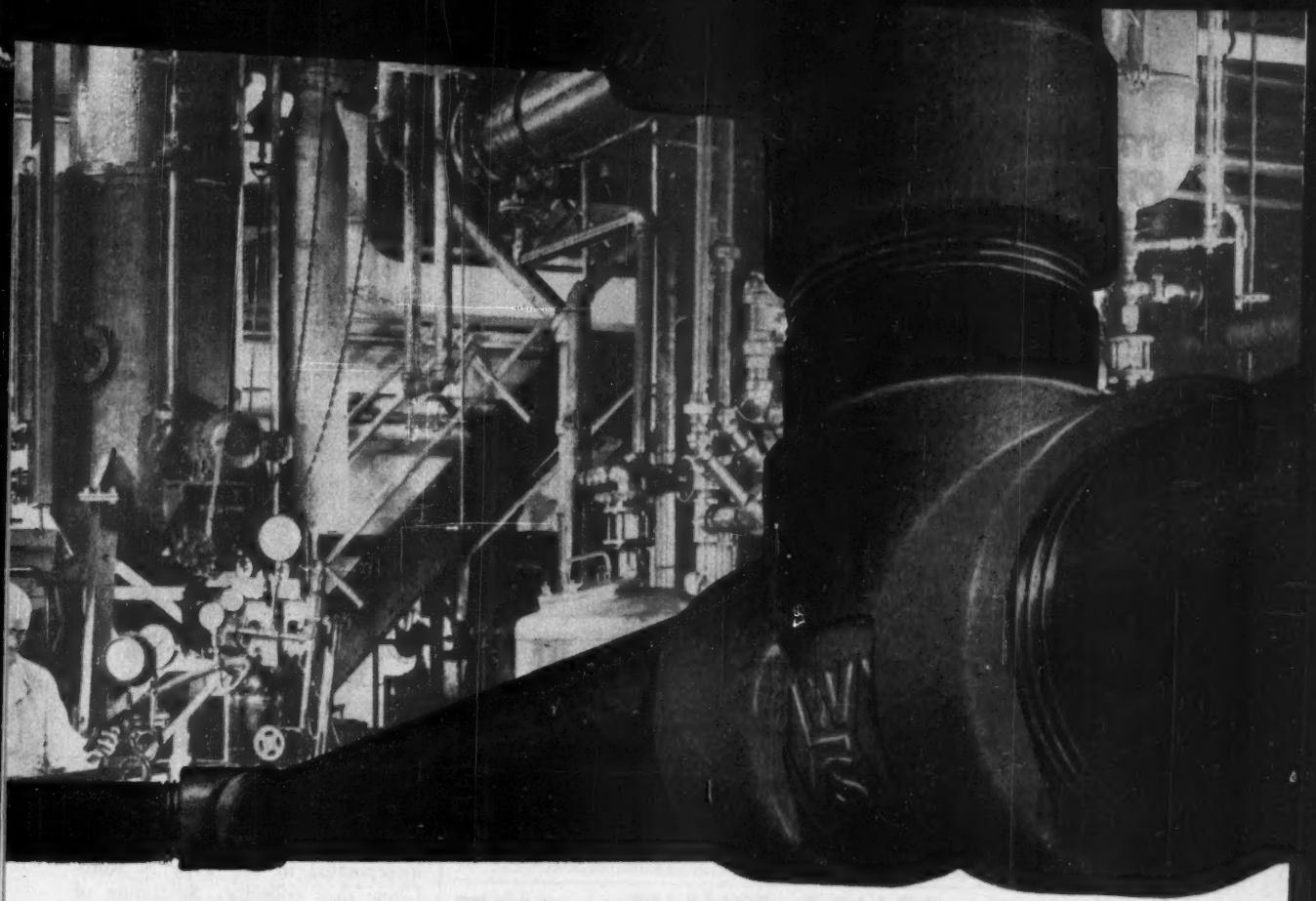
Primary sealing depends upon maintaining at all times an intimate contact between the sliding precision-finished surfaces of the gate and dual sealing rings. This accomplished by mounting the rings so that they are full-floating and self-aligning.

Polished surfaces of the port-plate and seals are so accurate and precise as to prevent entrance of foreign substances. Positive dead-tight sealing action is augmented by resilient O-rings. Both O-rings and sealing rings are held against the sliding port plate by spring-loaded piston sleeves.

Built to ASA and API standards these valves are available for service up to 10,000 psi. There is choice of carbon or alloy steel bodies and alloy or stainless steel trim.—*Grove Regulator Co., 65th & Hollis Sts., Oakland 8, Calif.*

Controlled Volume Pump For High Flow and Pressure

A new controlled volume simplex model pump provides a range of 1,450 gph. at 470 psi. to 14 gph. at 50,000



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FOR REAL ECONOMY on your next screwed fitting piping job specify Watson-Stillman the Double-diamond brand of Forged Steel Fittings.

You'll find their long, accurately cut threads, in perfect alignment, assure ease of installation.

You'll find their extra long bands extending well beyond the last thread, provide reinforcement at points of severest strain.

You'll find their heavy uniform fitting wall thickness provides a high safety factor to give you years of leak proof, trouble-free service.

Accurately machined . . . they fit tight and they're made of forging stock especially selected for toughness, strength, and resistance to temperature and shock. Available in carbon, stainless and chrome-moly alloy steels.

Watson-Stillman also makes a complete line of forged Socket-Welding fittings. Investigate these superior, life-of-the-system joints. Write for literature.

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STAINLESS STEEL PIPE AND TUBING.. FROM STOCK

A single call to a Murray warehouse can bring you everything needed in stainless pipe, tubing and fittings — and you can be sure of quick delivery from Murray's large stocks and complete range of sizes! Hundreds of tube users — both large and small — repeatedly rely on Murray for this dependable service.

When in need of stainless pipe, tubing or fittings — for pressure or mechanical purposes—call a Murray warehouse first and be sure of quick and dependable tubing service.

Photo courtesy of Shell Oil Co.

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Other Murray products include boiler and pressure tubes, IPS pressure tubing, seamless cold-drawn and hot finished mechanical tubing, seamless and welded pipe, JIC hydraulic tubing, carbon steel welding fittings and all types of tube fabricating.

WHEN PUMPS WEAR OUT . . . WHO IS AT FAULT?

CHECK IN-PLANT SERVICING

One of many Waukesha Pump "Life-Savers," this simple petcock can add *months* to pump service! Use it to drain condensate from your pump every time you clean it — daily. It's *important!* If you leave condensate in your pump, you saponify the oil . . . Your oil loses its lubricating value, and you have rapid wear on the ball bearings, causing misalignment of shaft — resulting in excessive wear on impellers and pump body. Shorter pump life, early repair and need for replacement!

SAVE YOUR PUMP . . . Make the "Petcock-Check" *every* day. Let it drain until the oil runs clear. Then check the oil level; add oil to fill — of the recommended type and viscosity. It's good "life insurance." Saves money — and new pump investment.

WAUKESHA P.D.* Sanitary Pumps are built for long life! Every detail in their design and construction confirms this. Service-conscious owners prove it every day, every year. That's why you'll find *more* Waukesha Pumps in use today for quality protection of all types of products, liquid, semi-liquid, creamy or chunky. Prove it yourself — write for latest Instruction Manual — or complete catalog.

*P.D.—Positive Displacement, slow speed

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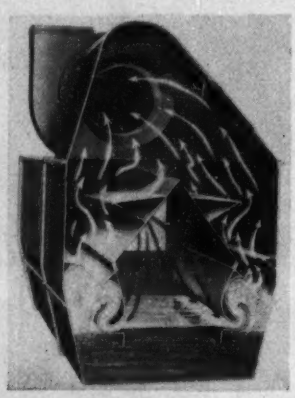
Petcocks also available for pumps now in use.

Waukesha 100% SANITARY PUMPS
Dependable Product of a Responsible Manufacturer

Equipment News, cont. . .

psi. Unit is also available in duplex for double these capacities over the same pressure range.

Pumps are available with constant or variable speed motors up to 30 hp. Capacity variation while running can be secured with either automatic or manual dial stroke length adjustment. —*Milton Roy Co., 1300 East Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa.*



Wet Dust Collector Has Improved Features

Improved design features have been incorporated in the Type N Roto-Clone dust collector. Separation of dust from air is obtained by means of an S-shaped water curtain.

Unit is available in three basic arrangements which are identical in operating principle, but differ in hopper design and means of sludge removal. Sludge may be removed by manual cleanout, continuous drain, or ejection by flight conveyors.

Other features are non-plugging water entrainment separators, heavier sludge ejection mechanism, wider range of sizes and capacities, and sectional construction to permit field conversion from one arrangement to another. Sizes now available range from 1,000 to 48,000 cfm.—*American Air Filter Co., Inc., Louisville 8, Ky.*

Pneumatic Control Valve Has Split Body, New Topworks

Outstanding features of a new line of pneumatic control valves are found in the topworks design and a split valve body.

The topwork contains an aluminum cylinder with carefully bored and honed internals. Piston is made of plastic with a graphite-impregnated O-ring seal. A unique, integral positioning device permits the static or

cushion loading pressure to be in either the upper or lower cylinder.

Coupled with a truly reversible Conoplug topworks, design permits any possible combination of forces to cope with unbalanced loads. Operator can position accurately to well over one part in 1,000 of instrument output span.

New LB valve series is presently available in sizes up to and including 4 in. A wide range of materials of construction are available.—*Conoflow Corp., Philadelphia 3, Pa.*

Portable electric laboratory mixer now available in explosion-proof construction for hazardous service. Mixer is direct-connected to 1/20 hp., 1,750 rpm. motor. It will mix up to 50 gal. of low viscosity fluid or a lesser volume of high viscosity material.—*Mixing Equipment Co., Inc., 135 Mt. Read Blvd., Rochester 11, N. Y.*

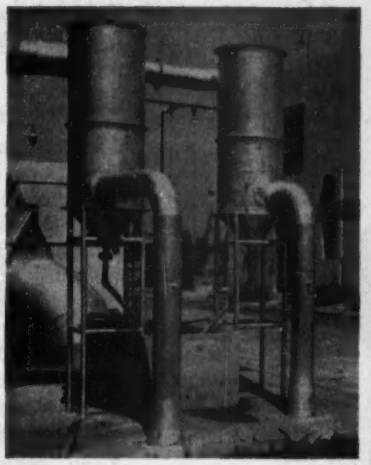
New line of portable propeller mixers being offered in sizes from ⅛ to 3 hp. Units can be furnished with drip-proof, totally enclosed or explosion-proof motors. Shafts and propellers may be constructed of ordinary metals or stainless steel.—*L. H. Butcher Co., 15th & Vermont Sts., San Francisco 1, Calif.*

Industrial bronze pump with scoop rotor and rubber roller vanes handles continuous water recirculation jobs. Model 4300 delivers 7 gpm. at 70 psi. and 1,750 rpm.—*Hypro Engineering, Inc., Dept KP, 404 North Washington Ave., Minneapolis 1, Minn.*

Rotary pump line extended by addition of 3600 series MAHBRV Nos. 5 and 6 motor driven units. Pumps have range of capacities from 70 to 226 gpm. at 60 psi. Each size has three interchangeable gear ratios.—*George D. Roper Corp., Rockford, Ill.*

Needle and globe valves made of Boltaron unplasticized polyvinyl chloride are now available in sizes ⅛ to 2 in. Valves are used with pipe and fittings of the same material for corrosion and chemical resistant piping systems. Reducing bushings, plugs, unions and caps have also been added to the fittings line.—*H. N. Hartwell & Son, Inc., Park Sq. Bldg., Boston, Mass.*

MULTI-WASH can clean-up your chemical contamination



Dust, fumes, vapors, soluble gases, acid gases and odors are most effectively removed.

Schneible Multi-Wash Collectors provide efficient removal of air-borne contamination and recovery of product through multiple washing action.

The counterflow action allows air, gas or vapors to pass spirally upward through several stages at a velocity that impinges or condenses the contaminant against wetted surfaces, where they are flushed down and out the outlet cone in the liquid. The water or liquid enters the unit through a full-sized, non-clogging pipe opening so that heavy concentrations of slurry may be recirculated.

The intensive action of the air stream with the liquid curtains and spray patterns has proven very successful in the removal of soluble gases and acid gases. The liquid used varies according to type of material to be collected. Complex odors are removed by the addition of oxidizing agents in the recirculating liquid.

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WRITE FOR NEW BULLETIN NO. 610 FOR FULL DETAILS

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Speed **· up to 12 bags per minute!**

Accuracy **· to within 1/10 pound!**

Whether batchweighing for formulations or bagging for shipment, you can speed filling and weighing operations — and get greater accuracy too — with a Thayer *Fully-Automatic* Net-Weighing Scale. Dry chemicals, plastics, etc. in powder, granulated or pellet form are readily handled by a unique feeding system that closely controls amount and rate of flow. Any free-flowing or flooding material may be handled with accuracy and speed. The entire weighing and discharging operation is *completely automatic.*

Thayer Net-Weighing Scales handle charges from 1 to 500 pounds. Exclusive shockproof leverage system — without wear-vulnerable knife-edge pivots — guarantees continued accuracy. Hopper and feeding system are stainless steel for maximum protection against corrosion and contamination.

Thayer Gross-Weighing Scales are also available for filling directly into bags, drums and cartons.

Checkweighing Problems? . . . write for information on Thayer Checkweight Scales which *automatically* indicate weight of filled container and then separate off-weight units from properly filled packages! Types available for packages weighing from 1 to 200 pounds at rates up to 60 packages per minute. Latest Model 1005 automatically checkweighs bags and cartons *before* they are closed!

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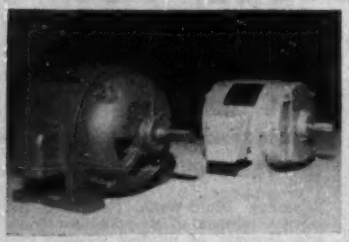
Where weight is worth money . . . it pays to be sure!



Electric Motor Is New in All Respects

New from top to bottom describes the Tri-Clad 55 electric motor. New engineering design, construction of new materials by new processes and new operating and maintenance features are offered in the Tri-Clad 55 motor.

Motors are built in accordance with the revised NEMA frame dimension standards. Average size reduction is 50 percent by volume; average weight reduction per hp. is 22 percent.

Distinctive features are much lower operating noise level, a new insulation system, new bearing assembly and a new ventilation plan. Cast-iron frame and end shields give greater rigidity. During the transitional period a complete line of custom-built adapter bases will be available.

Early in 1954 the Tri-Clad motor will be available in the 182 and 184 frame sizes (1, 1-½ and 2 hp. at 1,800 rpm.). Models will be horizontal drip-proof, totally-enclosed fan-cooled, and a complete line of gear motors.—*General Electric Co., Schenectady 5, N. Y.*

Powder Lance Pierces Metal Or Concrete

Combustion of metallic powder in a stream of oxygen gives the Oxweld ACL-1 powder lance a lethal punch for cutting and piercing operations. Lance is said to combine the advantages of powder cutting with the ease and efficiency of oxygen lance operations.

Heat generated by the burning powder is great enough to pierce holes in many materials that resist the standard oxygen lance. Blast furnace salamanders, concrete, cinder blocks, fire brick, aluminum billets, steel and cast iron containing inclusions all yield easily to the powder lance.

A special powder dispenser assures a continuous, steady flow of powder to the reaction zone. One simple lever controls flow of both oxygen and powder.—*Line Air Products Co., Div. of Union Carbide & Carbon Corp., 30 East 42nd St., New York 17, N. Y.*

Metal Working Electrode Acts As Heat Source

Acting as a source of instant heat the new ThermoTrode electrode is used for pre-heating, annealing and heat treating of weld areas. No metal is deposited. Instead the core metal is oxidized by the arc and disintegrated into an easily removable powder.

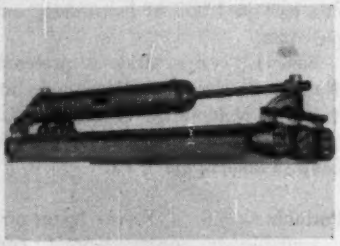
To use you merely insert the ThermoTrode electrode into the electrode holder of a d.c. arc welder. Proper manipulation of the rod permits application of heat over a wide area, it is said.

Electrodes are furnished in ⅛, 5/32 and ¼ in. sizes.—*Eutectic Welding Alloys Corp., 40-40 172 St., Flushing, New York, N. Y.*

Metallic Seals In Miniature Size

To meet industry demands for miniature, extreme temperature and high pressure, corrosion-resistant seals Toruseals now are offered in sizes from ⅛ to 1 in. O. D. Seals are manufactured from 5/32 in. dia. stainless steel tubing with a 0.005 in. wall. They work satisfactorily at temperatures from −150 to 1,000 deg. F.

Miniature Toruseals can be used effectively in small hydraulic, pneumatic and steam lines. They are adaptable to bolt heads, flanges and rivets as well as in standard AN fittings.—*The D. S. D. Mfg. Co., 2964 Whitney Ave., Hamden, Conn.*



Fluorescent Lighting Now Is Explosion-Proof

Use of fluorescent lighting in hazardous locations now is possible through a new type explosion-proof and dust-tight lighting fixture. Unit is recommended wherever the presence of explosive gases, vapors or combustible dust requires safe, practical lighting.

Each fluorescent tube is housed in an individual tube of heat-resisting glass. Tube ends are reverse tapered and sealed into cast aluminum housings, which also contain the lamp receptacles.

Relamping of the fixtures can be performed with ease. The relamping end of the fixture is lowered by unlocking a link member, after which the threaded receptacle covers are removed. Removal of these covers exposes the lamp receptacle and mounting plate assembles. A slight twist of the wrist unlocks these assemblies from the housing.—*Crouse-Hinds Co., Syracuse, N. Y.*

BENDER FOR CONDUIT SAVES TIME, LABOR AND MATERIALS

Electrical conduit now can be installed without need for elbows or couplings. Accurate bends are made with ease by one man using a portable conduit bender. Savings on total job cost may run 20 percent or greater. On the left you see the pipefitter operating the hydraulic cylinder to make a 45 deg. bend. Indicator shows when proper bend is reached. Finished bend is removed from shoe by pushing pin. —Tal Bender, Inc., Milwaukee 2, Wis.

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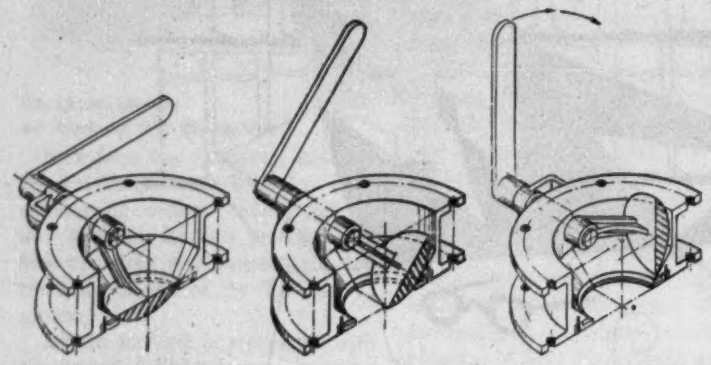
GEMCO SPHERICAL DUST-TITE VALVES

ALWAYS HAVE A CLEAN SEAT

The Disc Cleans The Seat



1. Both seat and disc are curved to a mating fit.
2. It is machined to close tolerances for accurate seating without the use of shims.
3. The valve opens freely to a full opening and there is nothing to obstruct the full flow of material or to cause bridging. The valve is made of hard, non-galling, abrasive, and corrosive-resisting materials.

GENERAL MACHINE CO. OF NEW JERSEY

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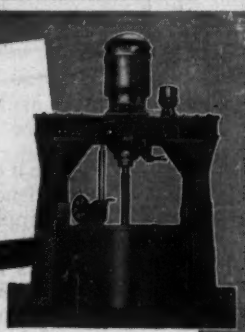
Fletcher CENTRIFUGALS



might break YOUR production bottleneck

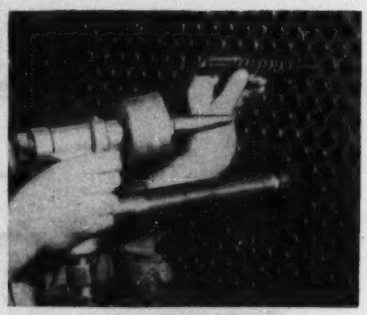
If you are interested in reducing centrifuging time, it will pay you to look into Fletcher's complete line of modern, high-speed centrifugals. These units, combining quick, safe acceleration and braking with easy loading and unloading ability are designed to give you the utmost in operating efficiency and safety.

Why not get in touch today with a Fletcher sales engineer who will be glad to suggest ways in which Fletcher can help solve your centrifuging problems.

FLETCHER CENTRIFUGALS

FLETCHER WORKS, 235 GLENWOOD AVE., PHILADELPHIA 40, PA.

EQUIPMENT NEWS, cont. . .

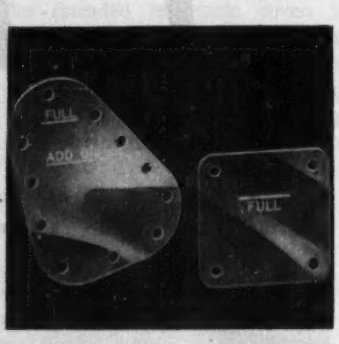


Condenser Cleaning Gun Shoots Brushes Through Tubes

Here's a new development to squelch any talk of disarmament among your maintenance men. It's a new, improved aluminum Jiffy gun that shoots spirally-wound nylon brushes through fouled condenser and heat exchanger tubes.

Spiral design of the nylon brushes gives them a spinning, scouring motion. With the flushing action of water from the gun they quickly remove sludge and soft deposits.

Brush is inserted into the tube. Then the gun nozzle is pressed into the tube end. This releases the water pressure and insures a tight fit between the tapered nozzle and the tube. Brushes are recovered from the other end and used over again.—*Elliot Co., Lagonda Div., Springfield, Ohio*

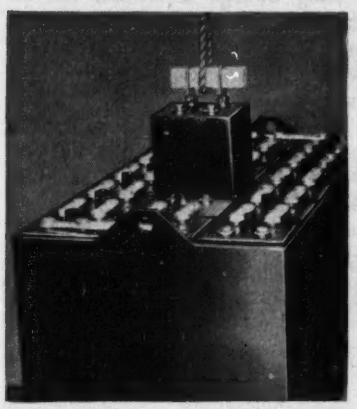


Oil Sight Glass Is Shatterproof

Oil sight glasses that withstand severe conditions are now being made from Kel-F plastic. They are said to remain transparent indefinitely, survive severe corrosion, extreme temperatures, shock and vibration.

Oils, sludges and acid products have no effect on the new glasses in the range of −65 to 300 deg. F. Exceptionally high compressive strength and resiliency withstand the strain from fully tightened mounting bolts. High

impact strength prevents damage from tools or rough handling.—*Nichols Engineering, Inc., Stratford, Conn.*

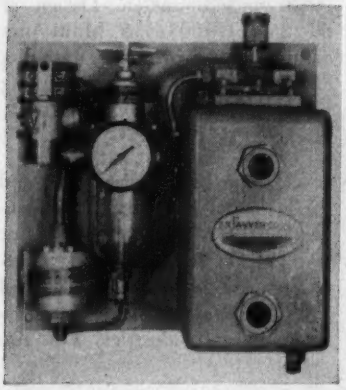


Pulling Tool
Used on Battery Cells

Users of storage batteries will find this new cell-puller useful for removing cells for examination or repair. Tool consists of a U-shaped steel loop brazed to a hexagonal steel nut. The nut has specially-cut threads tapering from bottom to top.

Generally, these threaded pullers are used in sets of two. The nuts are screwed down over the lead posts. A piece of wood then can be run through the two loops. A rope or chain passed under the wood will serve for hoisting cell from battery.

The same tool is used also with hold-down clips for removing the elements from the jar.—*Gould-National Batteries, Inc., Trenton, N. J.*



Oiling System
Delivers Fine Oil Mist

A constant and uniform oil film is delivered to bearings in the form of mist by the Oil-Air system. Oiling system has no moving parts; it operates solely on compressed air.

Air entering the Oil-Air unit at 100

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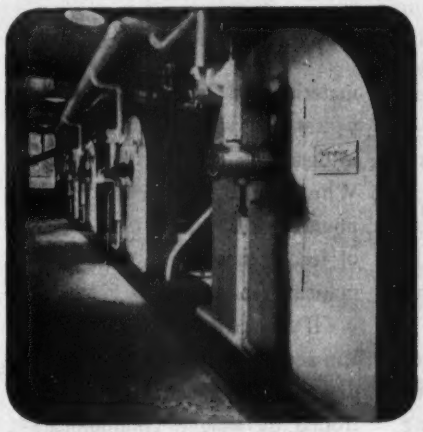
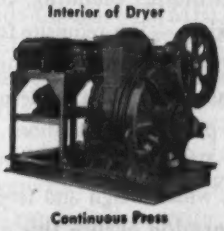


Interior of Dryer



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This type DAVENPORT installation includes a DAVENPORT Continuous Press and all necessary storage tanks. Accepted year after year as the most efficient and economical method of dehydrating semi-solid materials.

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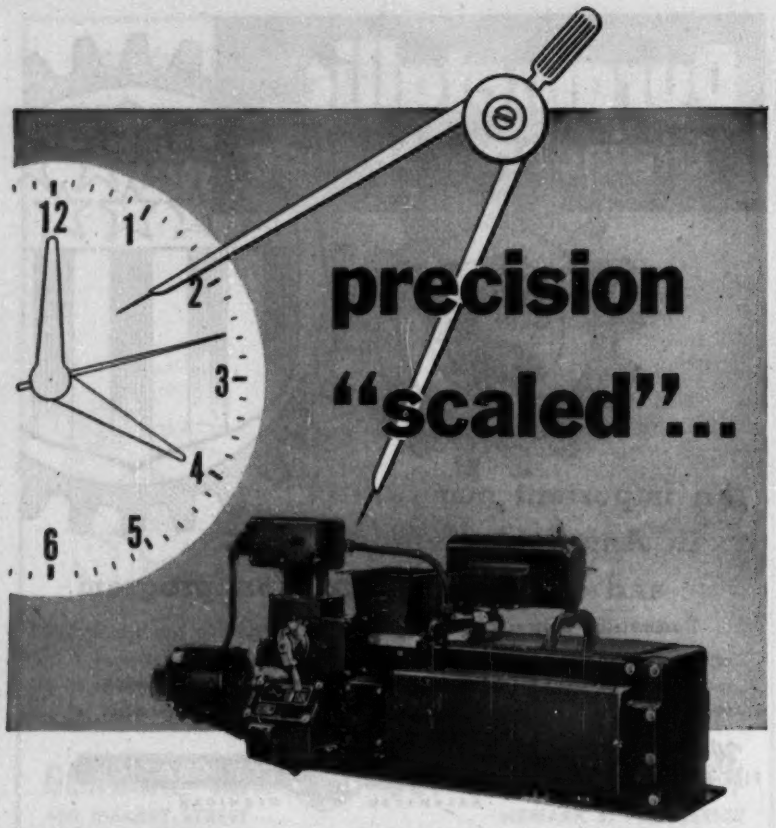

FOR MINUTE TO MINUTE ACCURACY

Minute to minute accuracy in the feeding of dry materials — uniform delivery to reaction tanks, continuous blending, or batch mixing — is a requisite for maintaining uniformly high quality in final products, in modern chemical processing operations.

W & T Merchen Scale Feeders which weigh and feed in one operation ensure this exacting accuracy. Precision "scaled", durably constructed and simply controlled, the Feeder weighs all material and immediately compensates by weight for variations in density, moisture content, etc. Whether feeding ounces or pounds per hour, the pre-set rate of feed is continually and automatically maintained.

If you have a processing problem requiring uniform feeding of dry materials, accurately controlled by weight, communicate with Wallace & Tiernan. You'll receive prompt attention without obligation.

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psi. is reduced in pressure to 10 psi. Passing through a venturi, the air draws oil from a reservoir. The oil and air mixture contacts a reclassifier which reduces it to a fine oil and air mist.

Oil-Air lubrication systems can be installed to deliver lubrication at any point either as completely atomized oil, oil spray, or reconverted to liquid oil.—*J. N. Fauver Co., Inc., 51 West Hancock, Detroit 1, Mich.*

Disposable industrial wiper is made of two embossed sheets of wet strength paper. Wipers are packaged 125 to a box.—*Scott Paper Co., Chester, Pa.*

D.C. arc welder offers reductions in size and weight, increased ease of maintenance and operator convenience. Machine incorporates all the advantages of the selenium rectifier type welder.—*Westinghouse Electric Corp., 401 Liberty Ave., Box 2278, Pittsburgh 30, Pa.*

Packing compound for valves, pumps and expansion joints is designed for steam, hot water or process air. Coppersticks consist of a dispersion of pure copper flakes evenly throughout a stick-shaped body.—*Surveys Inc., 219 Euclid Ave., Trenton, N. J.*

Portable tester for current-actuated protective devices now has a built-in six-range ammeter. Design of the model 1005/336 Multi-Amp eliminates the need for use of a clamp-on ammeter when running tests.—*Multi-Amp Corp., Harrison, N. J.*

New degreaser rapidly cleans oily and greasy parts in pure non-inflammable trichlorethylene vapors. Unit is standard 50-gal. barrel type requiring use of only 5 gallons of cleaning solvent for effective operation.—*Baron Industries, Los Angeles, Calif.*

Gearmotor line from 1 to 15 hp. offered in a wide range of speeds with single, double, or triple gear reductions. To fit varying load requirements, gears are furnished meeting AGMA Class 1, 2 and 3 specifications.—*Century Electric Co., 1806 Pine St., St. Louis 3, Mo.*

3000 impulses help keep mid-west refinery "on stream"

THIS big refinery at Lawrenceville, Ill.—like a lot of other important refineries — uses Yarway Impulse Steam Traps.

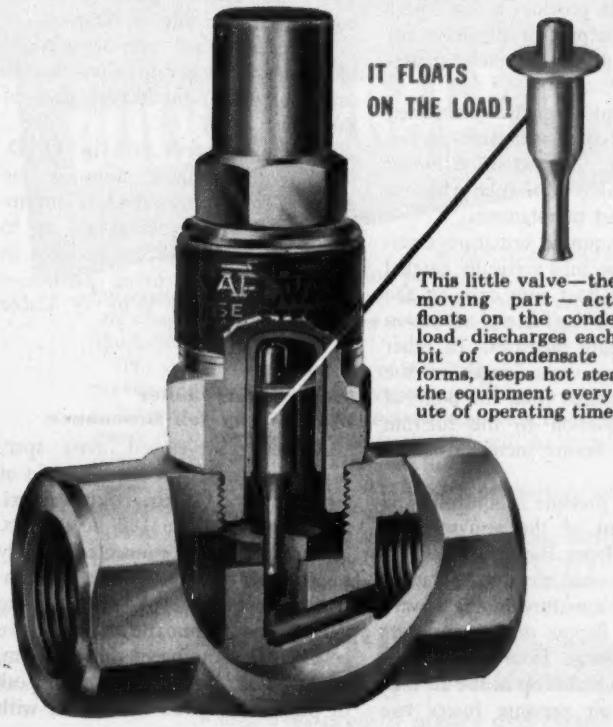
Over 3000 Yarway Impulse Traps are installed on tracer lines and for draining steam headers.

Popular features of the Yarway Impulse Steam Trap are its ability to get equipment *hot in a hurry*—and keep it hot! . . . also its small, handy size—fits in easily in any location; its stainless steel body and working parts; quick installation; easy maintenance; low initial cost.

Another advantage—IMMEDIATE DELIVERY from 250 local distributors, plus quick service from nearby Yarway field engineers.

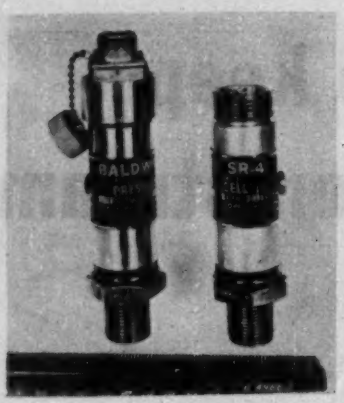
More than 900,000 Yarway Impulse Steam Traps have been sold. For a free Steam Trap Selector, write . . .

YARNALL-WARING COMPANY
137 Mermaid Ave., Philadelphia 18, Pa.



This little valve—the only moving part — actually floats on the condensate load, discharges each tiny bit of condensate as it forms, keeps hot steam in the equipment every minute of operating time.

YARWAY® impulse® steam trap



Strain Gage Pressure Cells For High Frequency Response

New SR-4 type HF strain gage pressure cells give high frequency response to pressure variations. They are ruggedly constructed and said to have exceptionally high accuracy and sensitivity.

Cell consists of a pressure sensitive tube. A strain gage is bonded to the outside of the tube.

Pressure changes may be measured by an electrical indicator or potentiometer recorder. However the cell usually is connected to an oscilloscope or oscillograph for high frequency response.

Upper frequency response is almost never limited by the pressure cell. Rather the cavity resonance of the tank or connecting piping is the limiting factor.

Long fatigue life is assured by the absence of moving parts. Temperature compensation is provided over a wide range to prevent changes of zero and sensitivity.—*Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.*

Vibration Relay Guards Rotating Equipment

Excessive vibration in heavy rotating parts can be damaging and costly. A new protective device warns immediately of such a condition should it occur. It can be used to guard turbine or water-wheel generators, large motors, blowers, steam or gas turbines and centrifuges.

The operating range of the new vibration relay allows its use at speeds from 300 to 18,000 rpm. It can energize warning-alarm, corrective, or shut-down devices at pre-set vibration acceleration values up to 20 g. A built-in fail-safe feature gives warning in case of relay failure. Relays can be calibrated readily in the field. They can be installed safely where conditions are dusty.—*General Electric Co., Schenectady 5, N. Y.*

Valve Controls Low Flow At Extremely High Pressure

Fluids handled on many experimental and development projects are exceeding acceptable pressure, temperature and flow ranges for conventional control valves. The Wee Willie Domotor control valve makes possible an automatic control circuit involving extremely small flow rates at exceptionally high operating pressures. Valve works up to 50,000 psi. with a range from 0.000001 to 0.1 gpm.

Valve is operated by a Domotor standard piston operator with built-in positioner. A plug operating force of 2,000 lb. min. can be developed. For on-off operation either a piston or solenoid operator can be furnished. —*The Annin Co., 3500 Union Pacific Ave., Los Angeles 23, Calif.*

Pneumatic Transmitter Actuated by Rotameter

A pneumatic transmitter for controlling flow is actuated by a magnet attached to the extension of a rotameter float. It provides a fast linear response in output air pressures for every position of the rotameter metering float.

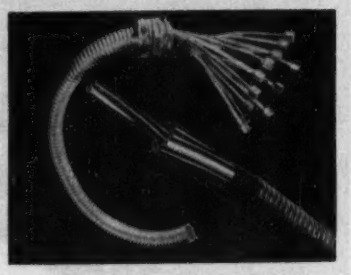
A permanent magnet is imbedded in a stainless steel extension of the metering float. The extension moves within a stainless steel tube which is an integral part of rotameter.

A flexure-mounted armature external to the tube runs vertically parallel to it. As the float rises carrying the magnet upward the force of attraction on the armature increases. In other words the lever arm length of the armature measured from the point of magnetic attraction to the fulcrum point at the flexure increases as the magnet rises.

Output air pressure is controlled by the movement of the armature. A vent nozzle from the controlled air supply is mounted close to the armature. As the armature moves toward the nozzle a flapper on the armature restricts discharge from the nozzle. Pressure then builds up in the air line.

Increased air pressure forces two pistons to push the armature in a direction opposite to the pull of the magnet. A force-balance system is thereby set up.

For each new position of the magnet, a corresponding directly proportional air pressure is produced. Any desired indicating and controlling receiver can be connected to the pneumatic outlet.—*Brooks Rotameter Co., Lansdale, Pa.*



Instrument Tubing Cable Saves Money on Long Runs

Substantial savings on moderate to long runs of instrument tubing are claimed through use of Armored Multitube. Cable is used where a number of tubes ¼ in. or smaller are needed.

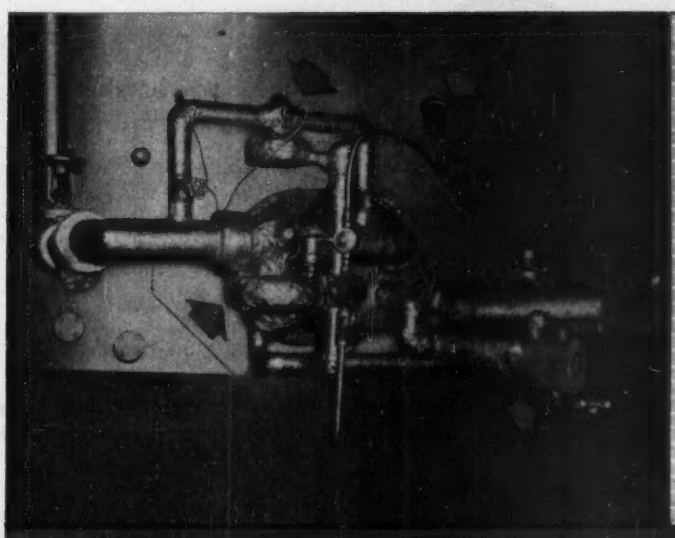
Armored Multitube contains from 2 to 19 tubes enclosed within a flexible interlocked galvanized steel armor. Tubes are twisted together to permit bending without any distortion.

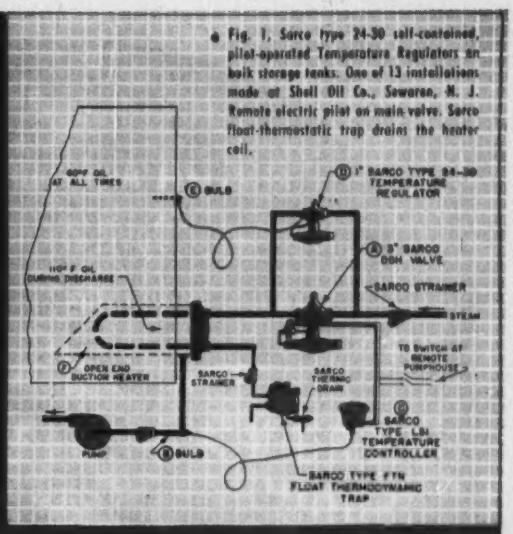
One tube in each layer has a bright blue color. This permits easy identification of each tube at both ends of the cable.

Two to 19 tubes in ¼ in. O. D. copper or aluminum normally are available from factory stock. Continuous lengths can be furnished up to 1,000 ft. Also tubes are available in polyethylene and other plastics.—*Crescent Insulated Wire & Cable Co., Trenton, N. J.*

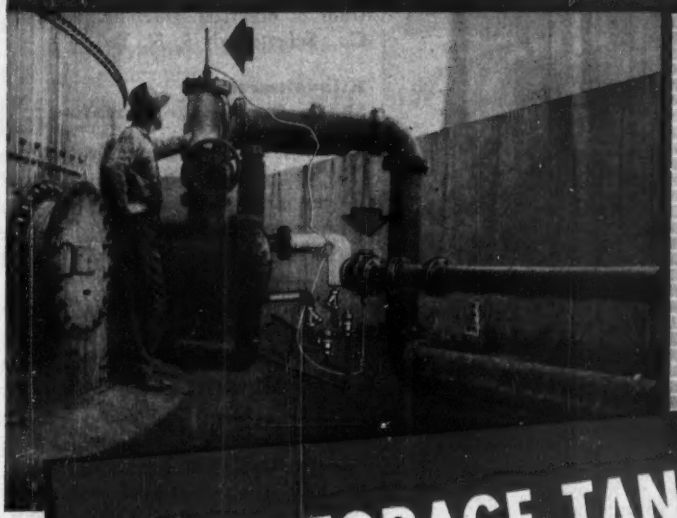
Mass Spectrometer Operates by Ion Resonance

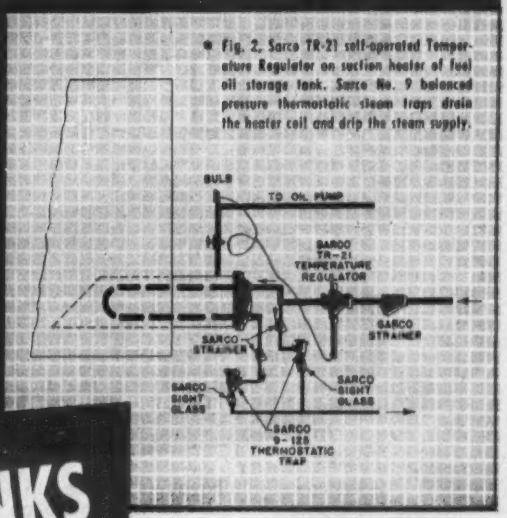
A newly developed mass spectrometer operates on the principle of ion resonance. It covers an approximate range of 1 to 100 mass units. Instrument can be connected directly to a stream or process line for continuous operation. A programming device allows automatic and repetitive continuous scanning of the spectrum; manual scanning or selection of peak or peaks of a given mass; and, with





● Fig. 1, Sarco type 24-30 self-contained, pilot-operated Temperature Regulators on bulk storage tanks. One of 13 installations made at Shell Oil Co., Sewaren, N. J. Remote electric pilot on main valve. Sarco float-thermostatic trap drains the heater coil.





● Fig. 2, Sarco TR-21 self-operated Temperature Regulator on suction heater of fuel oil storage tank. Sarco No. 9 balanced pressure thermostatic steam traps drain the heater coil and drip the steam supply.

BULK STORAGE TANKS

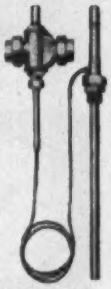
● SUCTION HEATERS, as widely used to bring heavy fuel oil in bulk storage to pumping temperature, require *fast acting* temperature control. All the controlling must be done while the oil is drawn off through the heater.

The control valve must be of the dead-end, *tight shutoff* type to prevent running away of the temperature when no oil is pumped out.

Sarco self-contained, pilot operated regulator, type 24-30, (Fig. 1) meets these requirements perfectly and will hold delivered fluid temperature constant within close limits.

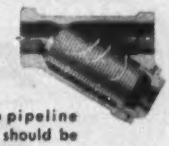
Fig. 2 is a simplified hook-up for low pressure steam, using self-operated regulator, type TR-21

Send for a Questionnaire or write for Catalog 600-14, to Sarco Company, Inc., Empire State Bldg., New York 1, N. Y. Branches in principal cities. Sarco Canada Ltd., Toronto 8, Ont.



Sarco self-operated Temperature Regulator, type TR-21, sizes ½" to 8", for low pressure steam.

Sarco pilot-operated Temperature Regulator, type 24-30 for dead-end service and high steam pressure.

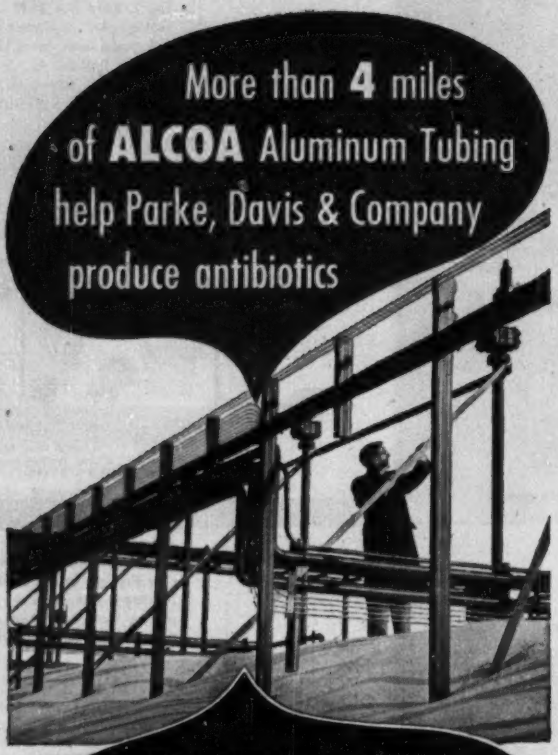


A Sarco pipeline strainer should be ahead of every regulator to keep out dirt and scale.

SARCO saves steam

improves product quality and output

418



ALCOA UTILITUBE—*more than four miles of it*—connects outdoor tanks with gages at Parke, Davis & Company's new Chloramycetin plant at Holland, Michigan—the world's only plant producing antibiotics by chemical synthesis. Alcoa's all-purpose aluminum coiled tube is used for instrument line service at this 124,000-gallon tank farm.

Alcoa Utilitube offers savings up to 40% over copper . . . has excellent on-the-job forming and flaring properties. It is available in economical, long lengths up to 1,000 feet or more, depending on size. It stands up well under vibration . . . has high resistance to most industrial atmospheres and to many liquids and gases.

In petroleum service, Alcoa Utilitube will not form sludge or gum . . . will not discolor or contaminate the fluid it carries.

Use Alcoa Utilitube for:

- Air for pneumatic and hydraulic control circuits.
- Gasoline and fuel oil for internal combustion engines.
- Lubricating oils for engines and machines.
- Fluids for hydraulic systems.

For complete details, write for the new booklet: "Alcoa Utilitube."

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minor modification, automatic monitoring of one or more peaks in sequence.

In the ion-resonance mass spectrometer, the ions are actually formed within the magnetic field. Ions of a specific mass are caused to follow a spiral path to a collector by applying a super-imposed, radio-frequency, electrostatic field.

By controlling the frequency, only ions of a definite m/r are caused to follow the spiral path. All other ions are drawn out of the analyzing region.

Thus, the signal received by the collector is indicative of the quantity and mass of the ions present. As the frequency is varied the complete spectrum is observed.—*General Electric Co., Schenectady 5, N. Y.*

Kilovoltmeter Shows Percentage Variation

A new Kilovoltmeter measures not only voltage but also percent voltage variations down to 0.05 percent. Meter measures voltages from 0 to 60 kv. in three ranges; 0—1,200 v., 0—30 kv., 0—60 kv.

Sensitivity of the meter is 20,000 ohms per volt for the 0—1,200-v. range; 25 to 50 microamperes full scale for the 30 kv. and 60 kv. ranges respectively.

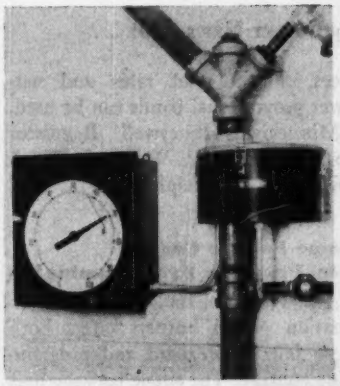
Accuracy for the kv. ranges and percentage readings is 3 percent; in the 0—1,200-v. range it is 2 percent.—*Neutronic Associates, 83-56 Vietor Ave., Elmhurst 73, N. Y.*

Electronic Controllers Cover Wide Range

New Free-Vane electronic controllers have been added recently to the series 500 line. Instruments are available as indicating or recording controllers for temperature, pressure, flow, liquid level, humidity and time program control. They use standard measuring elements.

Free-Vane instruments operate on a unique frequency modulation principle. They are offered for low-open, high-open, low-high, low-open-high or low-normal-high control. Also they are available for proportional input control.

Various combinations of recording pens make the new controllers adaptable to a wide range of control problems.—*The Bristol Co., Waterbury 20, Conn.*



Recording Turbidimeter Actuates Alarm System

A new recording turbidimeter continuously and automatically measures and permanently records turbidity in liquids. Instrument can be used with an audible or visible alarm.

Specific applications include chemical and paper plants with private water supplies where turbidity must be controlled; monitoring of wastes dumped into streams and lakes; water treatment plants as a measure of the quantity of flocculating agents required; and monitoring of process filtrates.

Operation is based on determining the ratio between the amount of light scattered by suspended particles and full transmission through a clear liquid. Detecting element is a single photovoltaic cell with current output proportional to the amount of light falling upon it. Light ratio is determined by computing voltage output of the photo cell when scattered light and then transmitted light are successively incident upon it.

With an operating pressure of 100 psi. max. inside the sampling head the turbidimeter has an accuracy of plus or minus 5 percent of full acale. Precision is plus or minus 3 percent of full scale. Range is adjustable in the field from 0-25 to 0-10,000 ppm. (silica scale).—*General Electric Co., Schenectady 5, N. Y.*

Pneumatic Controller Uses 3 Modes of Control

A miniature pneumatic-balance controller has been developed that incorporates three modes of control. Rate action has been added to the previously available, adjustable, proportional band response and automatic reset action.

The new controller permits faster, closer control of batch processes. It speeds recovery from process disturb-

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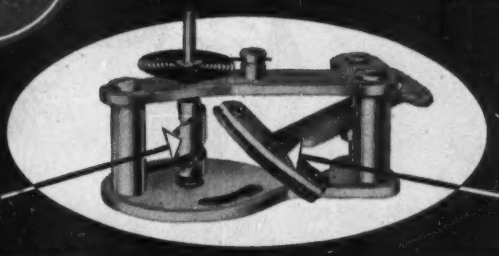

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Because of the ability of HELICOID'S cam and roller movement to stand up under unlimited pulsations, HELICOID Gages retain original accuracy longer, last longer, and cost less per gage, per year. Movement protects itself by releasing cam from roller at maximum dial graduation. Remeshing is positive, automatic, and instantaneous. No finer gages are made, yet you pay no more than for other quality gages.

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HELICOID Gages are made for vacuum, pressure, or compound service—in all pressure ranges. White, black, or radiant faces. Wall, stem, flush, and panel mountings, or flangeless cases.

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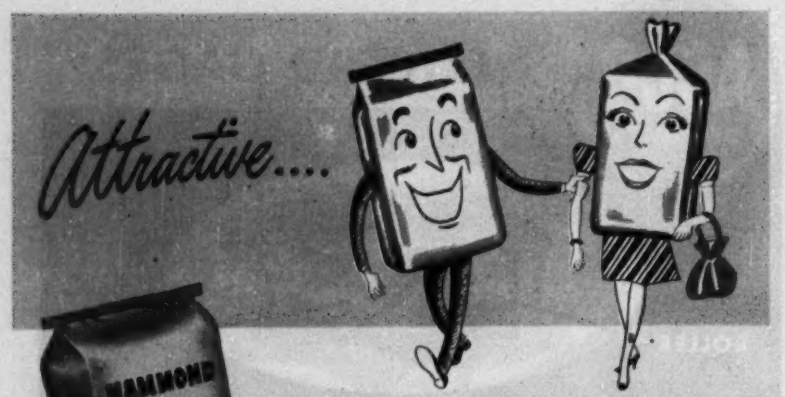

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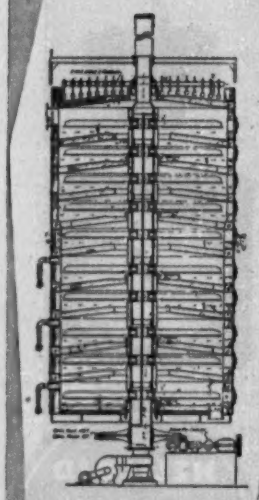

The Skinner Furnace, as manufactured by CIW, has produced outstanding results for many years on roasting, calcining and drying ores, clays, limestones, limestone mud; decomposing oil sludge in the process of recovering sulphuric acid; incinerating sewage.

Some of its many advantages are easy access during operation; quick replacement of rabble arms and teeth without cooling; up or down draft and multiple gas off-takes provide wide range of temperature control.

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ances. Faster reset rates and narrower proportional bands can be used. —*Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne & Windrim Aves., Philadelphia, Pa.*

Flame Failure Control Also Provides Programming

A new control for gas, oil or combination gas-oil burners offers both flame failure safeguard and programming control. The single package unit gives complete automatic startup, operating and shutdown control for any type of burner.

Included in the Fireye control is a flame sensitive Firetron cell. It shuts off fuel in 2 to 4 seconds after a burner flame goes out.—*Combustion Control Corp., Dept N, 718 Beacon St., Boston 15, Mass.*

Low cost precision temperature control covers three temperature ranges from −100 to 600 deg. F. Red and green signal lights indicate whether temperature is above or below set point. Control options are on-off, two-position, floating, proportioning.—*Minneapolis-Honeywell Regulator Co., Industrial Div., Wayne &Windrim Aves., Philadelphia 44, Pa.*

Portable smokescope gives precise indication of density of smoke stack effluent. A lens projects a virtual image of the reference standard to a focal distance equivalent to that of the stack.—*Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8, Pa.*

Electronic level control operates by a change in electrical capacitance with the approach of any material that flows. Instrument provides control of level within ⅛ in. Tektor models 101 and 102 use only one radio tube; there are no moving parts.—*Fielden Instrument Div., Robertshaw-Fulton Controls Co., 2920 North Fourth St., Philadelphia, Pa.*

Line of dust measuring instruments, manufactured in England, now available in U. S. Four different units perform different functions in the sampling of air borne dust and bacteria.—*Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh 8, Pa.*

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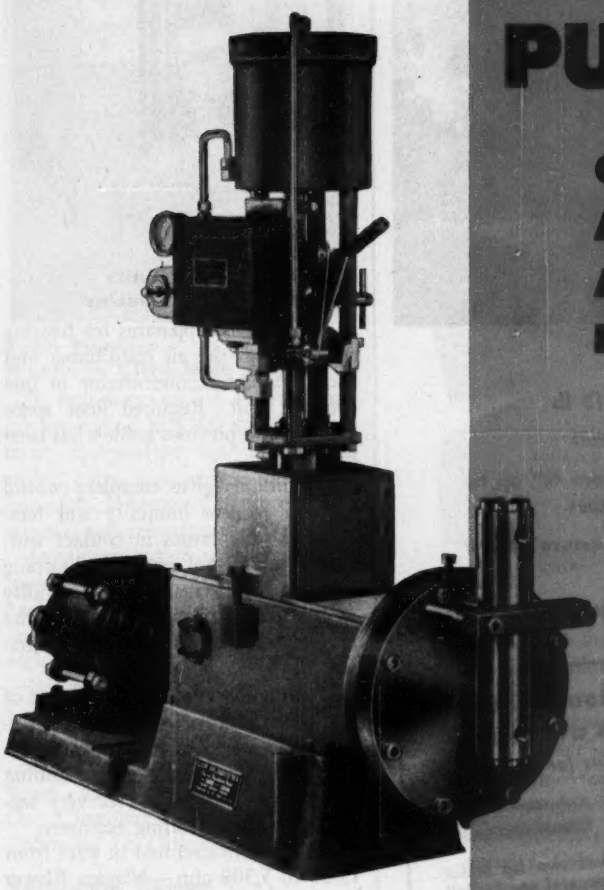
The Lapp Auto-Pneumatic Pulsafeeder has made possible automatic continuous processing in many processes involving chemicals or mixtures which have not been satisfactorily handled by pumps of conventional construction. In this construction, pumping rate is controlled by instrument air pressure responsive to variable flow, pH, temperature, liquid level, pressure, or any other instrument-measurable processing variable. And now, new improved Auto-Pneumatic instrumentation provides for greater capacity and/or pressure—full ratings as listed for manually-controlled models.



TWO PUMPS IN ONE!

Lapp Pulsafeeder is the combination piston-diaphragm pump for controlled-volume pumping of fluids. Reciprocating piston action provides positive displacement. But the piston pumps only an hydraulic medium, working against a diaphragm. A floating, balanced partition, the diaphragm isolates chemical being pumped from working pump parts—eliminates need for stuffing box or running seal. Constant pumping speed; variable flow results from variation in piston-stroke length—controlled by hand-wheel, or, in Auto-Pneumatic models, by instrument air pressure responding to any instrument-measurable processing variable.

WRITE FOR BULLETIN 300 with typical applications, flow charts, description and specifications of models of various capacities and constructions. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Div., 112 Wilson St., Le Roy, N.Y.

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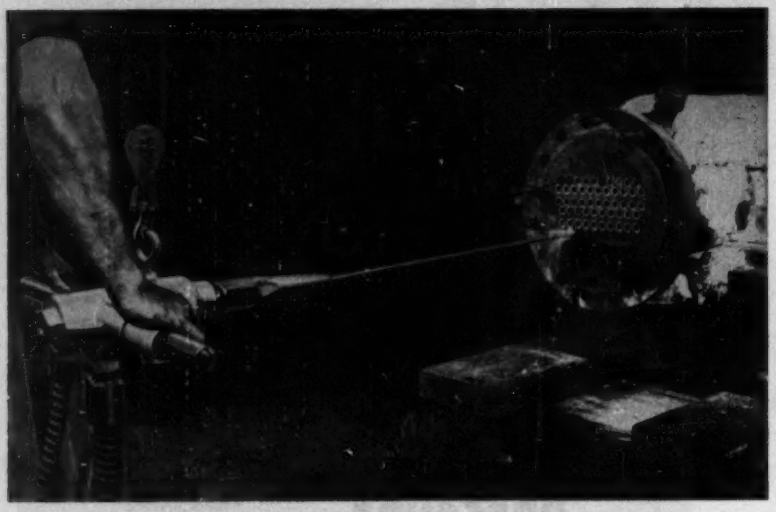
cleans fouled tubes faster



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TUBE CLEANER
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- Increased capacity—from ⅜" up to 2½" or even 3" OD tubes
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Here is the fastest, most economical tube cleaner on the market for refinery and process heat exchangers. The Wilson Model TP-301 is the only tube cleaner which can immediately remove deposits from completely plugged heat exchanger tubes. No matter how badly tubes are fouled, the Model TP-301 puts equipment back "on stream" with a minimum of manpower and a few hours work. • Use this high speed tube cleaner to step up profits, increase output and minimize downtime. •

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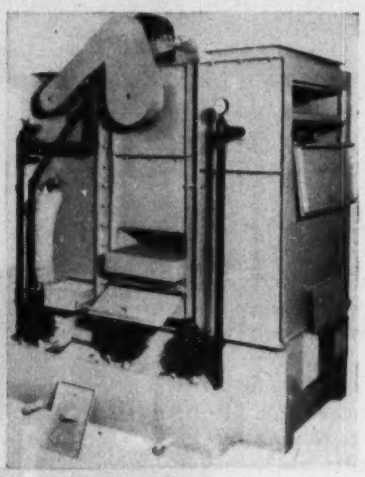

Air Conditioning Units Combined in One Housing

An improved apparatus for treating air combines the air conditioner and the absorbent reconcentrator in one compact unit. Required floor space compared to previous models has been halved.

Conditioner gives complete control over air relative humidity and temperature. Air comes in contact with a spray of Hygrol moisture-absorbing liquid. Temperature and humidity of the treated air is governed by the temperature and absorbent concentration of the Hygrol spray.

Control of the unit is by the use of thermostats; no moisture sensitive instruments are required. A heat interchanger between the air conditioning section and the Hygrol recovery section improves operating economy.

Unit is manufactured in sizes from 1,000 to 5,300 cfm.—*Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y.*

Packaged Steam Generator Features Two-Pass Design

An automatic steam generator, 20 to 500 hp., features a two-pass design. This eliminates need for refractory baffles or partitions in front or rear. There is easy and full access to all fire surfaces.

All return tubes are arranged to do an equal amount of work. This affords an improvement in uniformity of longitudinal expansion over the entire structure of the pressure vessel.

Flow of combustion air is governed to give a controlled mixture of fuel

and heated air. This creates a highly radiant flame with a high rate of heat transfer.

On the return pass the hot gases are given a spiraling motion by impellers or vanes located in each tube. Heat transfer is thereby improved and stack gas temperature lowered. Under normal operating conditions stack temperature is guaranteed not to exceed 125 deg. F. above saturated steam temperature at the operating pressure.—*Continental Boiler Div., Boiler Engineering & Supply Co.*

Tube Furnace Works in Ultra-High Range

A new water-cooled tube furnace can operate up to 5,000 deg. F. Maximum temperature can be reached within 2 hrs. Uses are foreseen in the formation, fabrication or processing of ceramic and refractory materials.

Even-temperature zone of the tube furnace is 12 by 3 in. I.D. with a full heated length of 26 in. Elements are water cooled and completely protected with fail-safe electrical interlocks.

Power is continuously variable from 1 to 100 percent of connected load. Furnace may be equipped with either Ignitron-Thyraton or saturable reactor power supply.—*Pereny Equipment Co., Chambers Rd. & Hesse Blvd., Columbus 12, Ohio*

Anthracite Burner Boosts Boiler Output

Output of steam and hot water boilers can be boosted by at least 15 percent with a new automatic firing anthracite burner, it is said. Increased output results from a unique design which circulates water through the burner to the boiler. The heating capacity of one sq. ft. of active burner area is equal to 5 sq. ft. of prime boiler surface.

The Fire-Jet burner can be used with either steel or cast iron boilers. Any standard anthracite grades will give top performance.

Essentially the Fire-Jet consists of a burner installed inside the boiler. It is gravity fed with coal from a hop-

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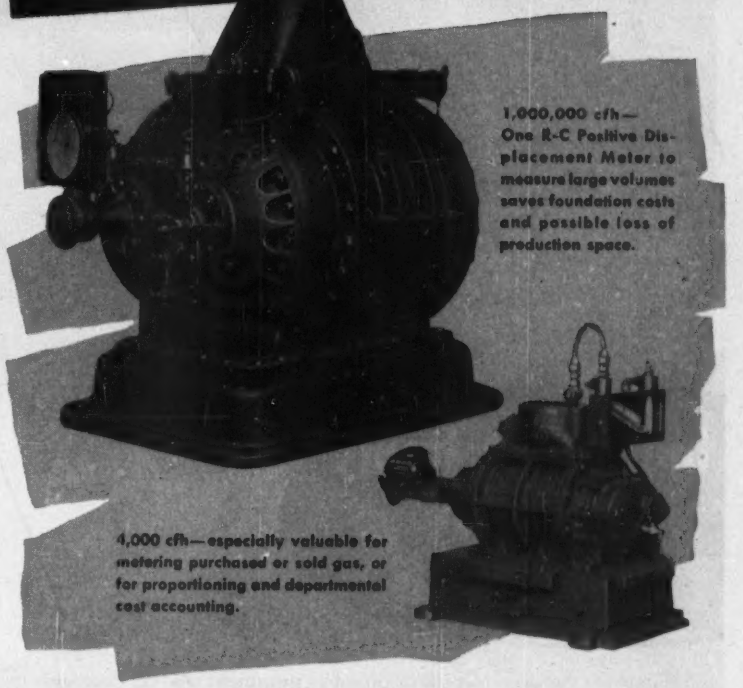
1,000,000 cfh—One R-C Positive Displacement Meter to measure large volumes saves foundation costs and possible loss of production space.
4,000 cfh—especially valuable for metering purchased or sold gas, or for proportioning and departmental cost accounting.

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Capacity—from 4,000 cfh to 1,000,000 cfh in one unit, with ample ability to absorb overloads.

Compactness—smallest made for industrial use in foot-for-foot of capacity. Can be located in otherwise unusable space, thus saving production areas.

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A new bulletin, M-152, gives complete data on R-C Meters, including a handy selection table which simplifies your choice of the right meter to suit your specific application. Your copy will be sent on request.

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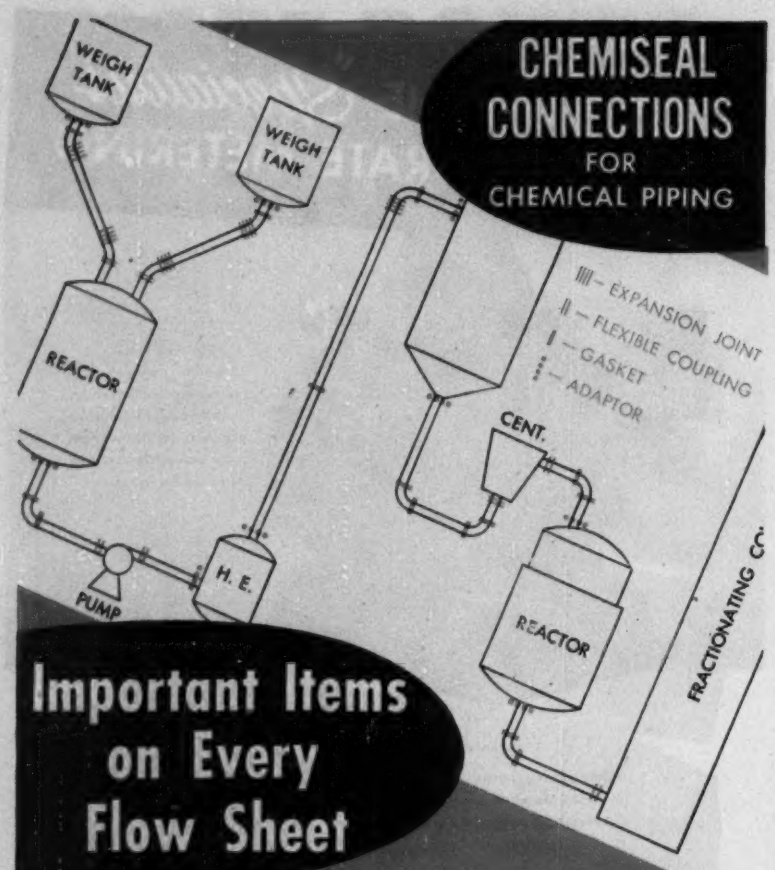

Important Items on Every Flow Sheet

Whatever the pipe-to-pipe or pipe-to-equipment sealing problem—whatever the materials of construction or flange specifications—whatever the mechanical or thermal shock or movement involved—there are engineered Chemiseal Connections to fill the bill.

CHEMISEAL GASKETS include Teflon®-Jacketed, soft filler types for Corning-conical flanges and glass lined steel connections; Snap-on type gaskets molded from Teflon to match contour of conical-end glass pipe; Teflon cut gaskets, available either as ring or full face gaskets for all standard pipe flanges or for irregular shaped openings.

CHEMISEAL EXPANSION JOINTS—utilizing a Teflon Bellows of several convolutions, and permitting maximum axial expansion and contraction of piping. Connect unlike piping ends and nozzles without gaskets or adaptors.

CHEMISEAL FLEXIBLE COUPLINGS—close-coupled expansion joints with only two bellows convolutions. Particularly suited for absorption of vibration and correcting slight misalignments of piping.

CHEMISEAL ADAPTORS—connect unlike piping ends and nozzles. A cushioned, rigid steel core is contained in a Teflon Jacket, providing easy-to-handle single units.

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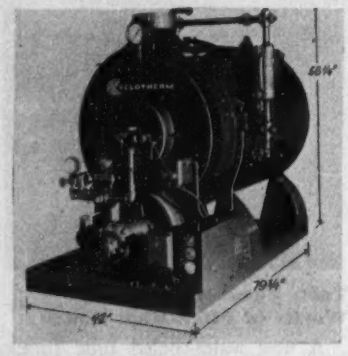
per located outside. A fan forces air through the tuyeres in the burner. Fan motor also oscillates the burner periodically to distribute coal evenly over the fire-bed surface.

Top efficiency is achieved within 10 min. after firing up. Program firing can be used where heat demand is intermittent.—*Electric Furnace-Man, Inc., Emmaus, Pa.*



Small Packaged Boiler Needs Less Space

Claimed to be the smallest 50 hp. fire-tube steam boiler ever manufactured the Cyclotherm C1725 is now in production. Unit requires half the floor space and 2 ft. less head room than other steam generators of equal horsepower.

Boiler weighs 3,550 lb., occupies 20 sq. ft. and stands 4 ft. 8¼ in. high. No cement foundation is necessary. A simple flue vent permits operation at about 80 percent efficiency continuously.

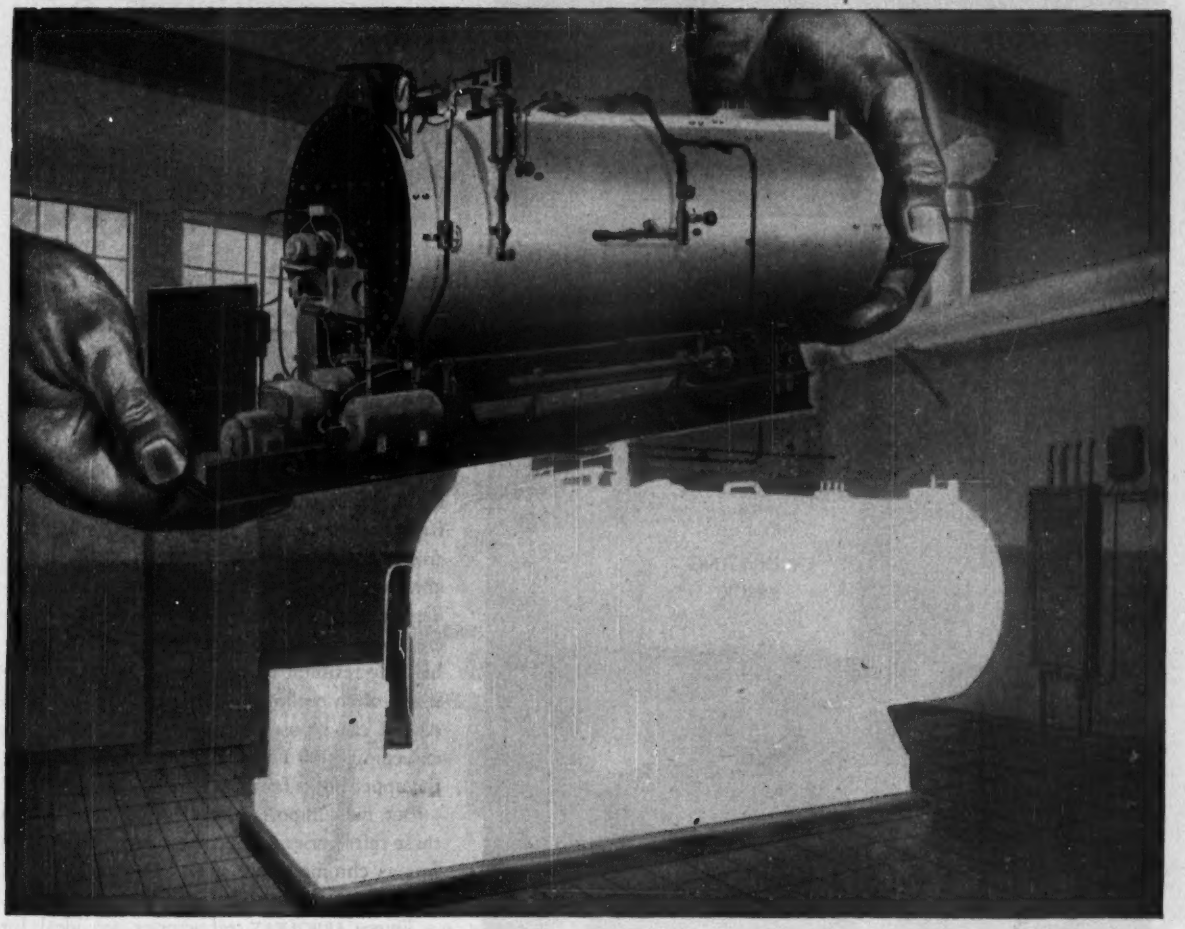
Company officials expect the C1725 to bring new steam producing economy to small manufacturers. On larger installations use of multiple units will give increased flexibility.—*Cyclotherm Div. United States Radiator Corp., Oswego, N. Y.*

Steam Valve Is Non-Fouling

Common troubles with steam valves is sticking, caused by high temperatures combined with deposits of iron oxide, boiler compound, and lime. A new steam valve design automatically compensates for normal steam valve life, and less maintenance trouble and cost—*Atkomatic Valve Co., Dept. 74, 545 Abbott St., Indianapolis 25, Ind.*

—End

Here's why you get more...when you buy a Cleaver-Brooks Self-Contained Boiler



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Cleaver-Brooks, originators of the self-contained boiler, offers wider experience that counts in another important way. Qualified engineers help you plan steam plants tailored *exactly* for your needs. Carefully analyzed are loads, space and equipment arrangement. This not only helps you solve present steam needs, but adds flexibility for future expansion as well.

This application engineering, plus basically sound design and construction is your assurance of a full return from your boiler investment. When you specify a self-contained boiler — make sure it's a Cleaver-Brooks.

Send for Catalog AD-100 for full details on Cleaver-Brooks boilers. Available for oil, gas and combination oil/gas firing. Sizes 15 to 500 hp, 15 to 250 psi — for heating and processing.

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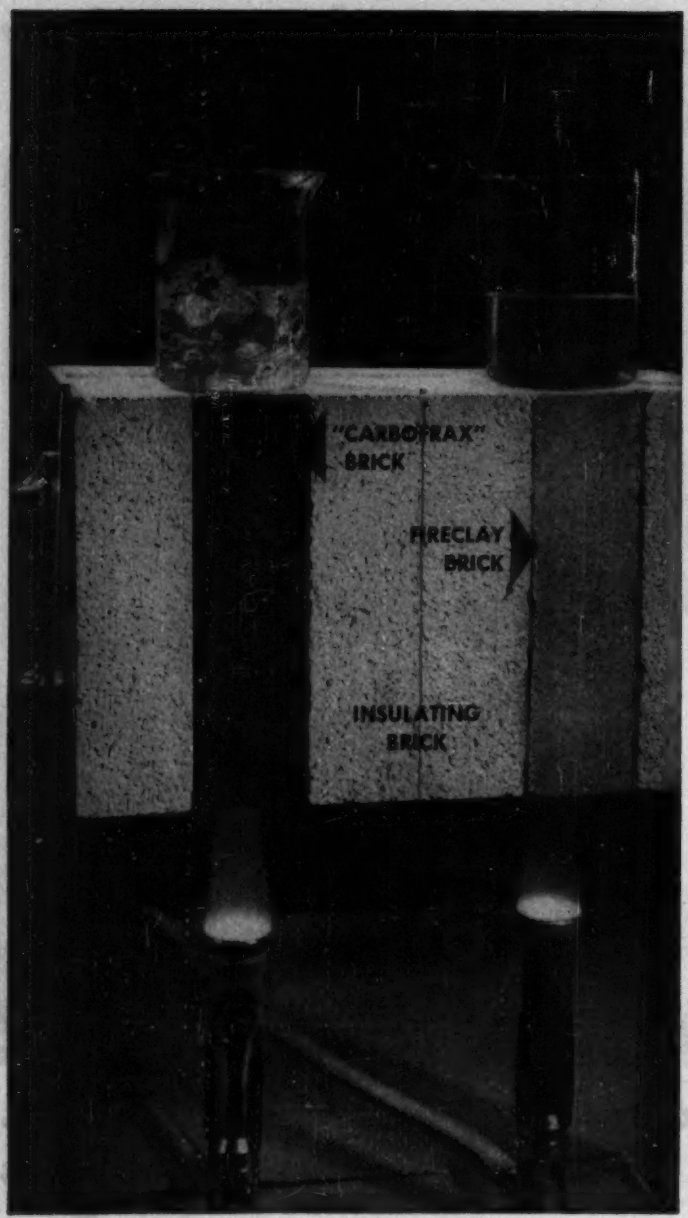
Milwaukee 12, Wisconsin, U.S.A.

Cleaver-Brooks

ORIGINATORS OF THE SELF-CONTAINED BOILER

Steam Boilers • Oil and Bitumin Tank Car Heaters • Distillation Equipment Oil and Gas Fired Conversion Burners



Two Meeker burners, two bricks — but see the difference! The beaker on the CARBOFRAX brick boils furiously (through the *length* of a 9" brick). The water on the fireclay brick is barely tepid.

Could you use a

Refractory that transmits heat

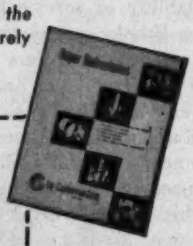
. . . as rapidly as chrome-nickel steels?

Here's a refractory that, in certain respects, is more akin to heat-resisting metals than to refractories. CABOFRAX silicon carbide refractory (same basic material as CARBORUNDUM brand abrasive) is, in many ways, one of the most indestructible of materials. At 2460 F., it has a crushing strength of over 10,000 psi. It is inherently resistant to even the most severe abrasion—often outlasting alloy parts, 5 or 10 to 1. And it can be used at temperatures up to and exceeding 3000 F.... roughly 1000 degrees over the upper limits for metals!

But, most important, at elevated temperatures these refractories conduct heat approximately as fast as chrome-nickel steels. This is 11 to 12 times faster than fireclay refractories!

Thus CARBOFRAX refractories are ideal for radiant tubes, muffles, hearths, and other equipment using *indirect heating*. Since they absorb and release up to five times as many BTU's per second as fireclay, they are also perfect for *heat exchange* equipment, such as checkers or recuperator tubes. Conversely, these refractories play an important role where heat must be *dissipated* (e.g. arc shields, pot linings, etc.).

Do any of these applications suggest possibilities? If so, please write or phone us. And be sure to get our easy-to-read 20-page booklet. It describes the many unusual properties of our Super Refractories line. No obligation, of course.



Dept. H-123 Refractories Division
The Carborundum Company, Perth Amboy, N. J.

Send complimentary copy of Super Refractories booklet to:

NAME_____
POSITION_____
COMPANY_____
STREET_____
CITY_____ ZONE____ STATE_____

Super Refractories by
CARBORUNDUM
Trade Mark

"CARBORUNDUM" AND "CARBOFRAX" ARE REGISTERED TRADEMARKS OF THE CARBORUNDUM CO.—WORLD'S LARGEST MANUFACTURER OF SUPER REFRACTORIES

Compact...

ALL-METAL **Circle** SIFTER

Thirty-Five SQUARE FEET OF SCREENING AREA IN NINE SQUARE FEET OF FLOOR SPACE

WHEN STEPPED-UP PRODUCTION shrinks your floor space, consider the logic of installing the compact *Circle* Sifter. By stacking sieves, this space-saving unit provides a screening area equal to that of a deck-type screen requiring *four times the floor space.* The installation of a sturdy *Circle* Sifter entails no structural modification. Dynamically balanced, the gyratory motion is smooth, quiet and vibrationless.

Flexible Capacity

The multiple screen arrangement also affords flexible capacity. Three to seven screens may be used to meet your production needs. (Five-screen unit shown.) Power requirements are low. A ¾-hp motor drives the three and four-screen unit; a 1-hp motor, the larger assemblies.

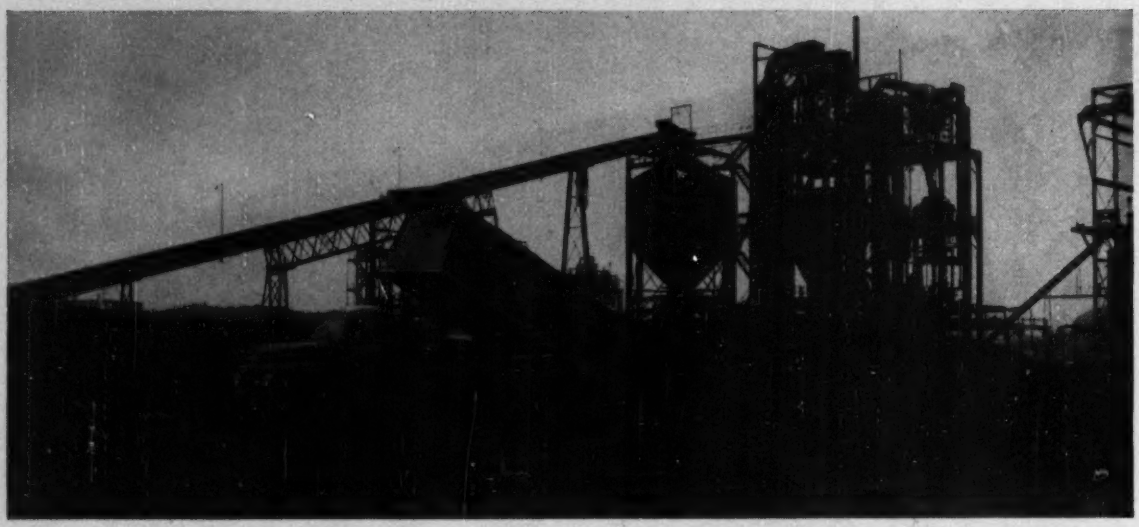
Other *Circle* Sifter advantages include high capacity to screen area ratio, quick product change-over and simplified sanitation.

For complete information, contact your nearby A-C representative, or write for Bulletin 06B7625A, Allis-Chalmers, Milwaukee 1, Wisconsin.

Circle is an Allis-Chalmers trademark. A-4095

ALLIS-CHALMERS

Chemical Milling and Processing Equipment



1 Coal storage, grinding and paste area. Coal is pulverized, dried and the paste prepared in the equipment at right.

Aromatics From Coal

A CHEMICAL ENGINEERING PICTURED FLOWSHEET

The Carbide and Carbon Chemicals Co. $11 million coal hydrogenation pilot plant opens way for large scale production of aromatic chemicals.

Up until very recently the chemical industry depended on a byproduct of coke—coal-tar—as a main source of basic aromatic chemicals. A forward step was taken in 1952 to alleviate this situation with the start-up of the Carbide and Carbon Chemicals Co. $11 million coal hydrogenation pilot plant at Institute, W. Va.

Capable of supplying aromatic chemicals in large quantities and at low cost, the Carbide process promises to free the industry from dependence on coking operations.

The basic approach that Carbide engineers used in hydrogenating coal was not much different from established methods. Big improvements, however, have been made in equipment design and process procedures. This is the result of skillful and ingenious use of modern chemical engineering theory and practice (see Chemical Engineering Achievement Award, pp. 177-184). Here is how the process works:

Pittsburgh No. 8 coal (the Carbide unit is designed for treating 300 tons of coal daily) is crushed; pulverized to 20-mesh; dried; and slurried in a paste mixer with aromatic oil. The slurry or paste has about 25-40 percent coal.

Oil-coal paste is mixed with a catalyst and pumped at 4,000 to 6,000 psi. to the hydrogenation area.

Recycle or makeup hydrogen is brought into contact with the viscous coal paste in an electrically heated preheater.

From the preheater, the mixture of coal solution and hydrogen flows to a high pressure liquid-phase continuous converter. Here hydrogen reacts with the coal-oil solution. This reaction takes place at temperatures between 840-1,000 deg. F. and pressures of 4,000-6,000 psi.

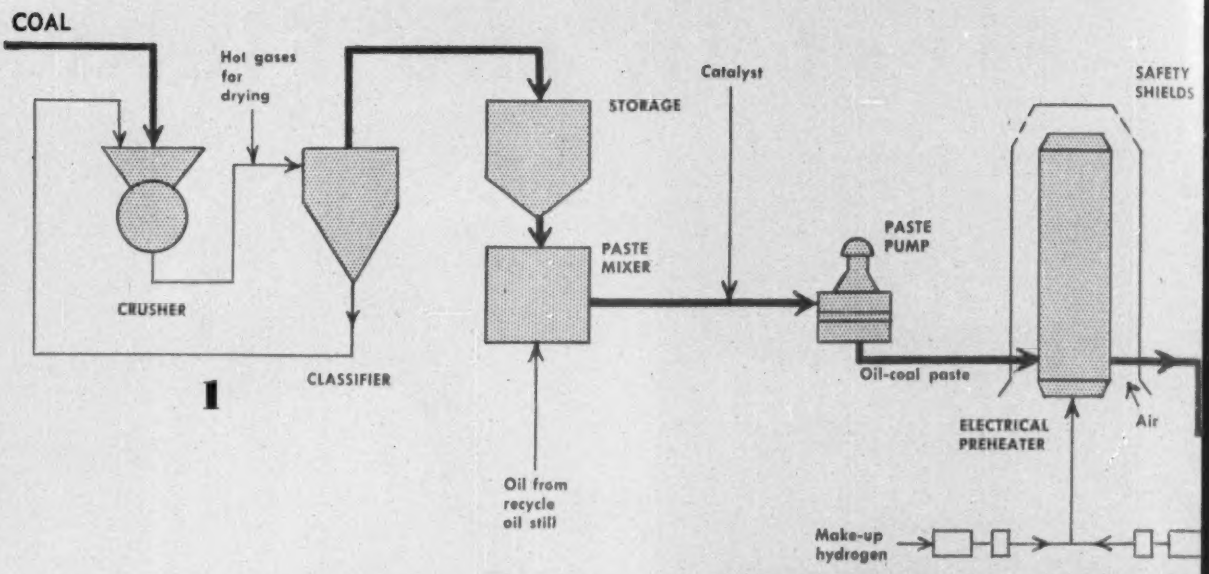
Leaving the converter, the reaction mixture goes to the "hot" separator. Liquid and vapor streams are separated here.

The liquid stream is further separated by filtration and distillation into solids (ash, unreacted coal and fusain carbon), coal-dissolving oil, and pitch.

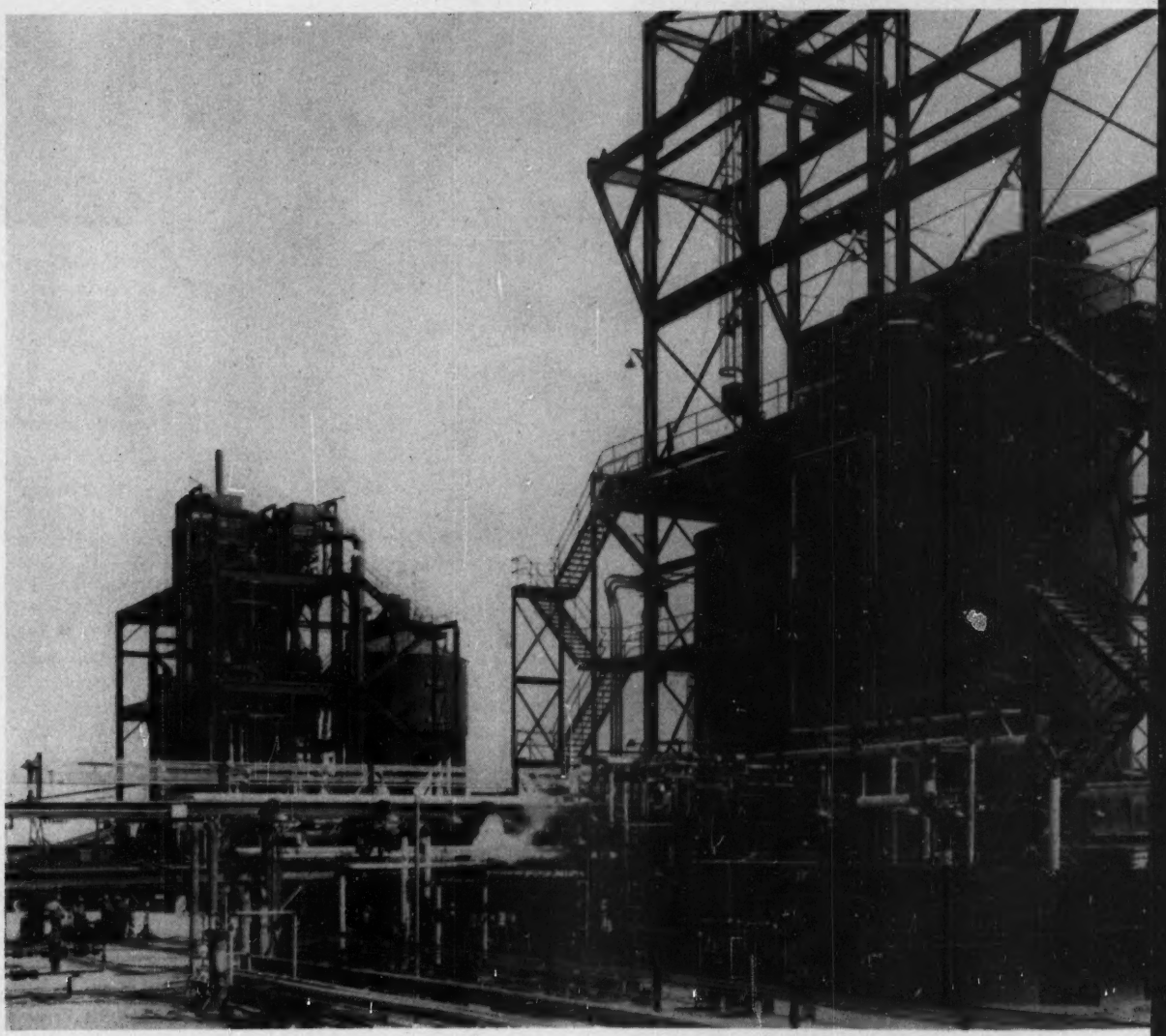
From the "hot" separator the vapor stream passes through a heat exchanger and into a "cold" separator. Here the stream is split into liquid and gas phases. Most of the gas (H_2, NH_3, H_2S, CH_4–C_4H_{10}) is sent to a hydrogen compressor and used as recycle hydrogen feed for the preheater.

The liquid phase from the "cold" separator goes to the chemicals separation plant.

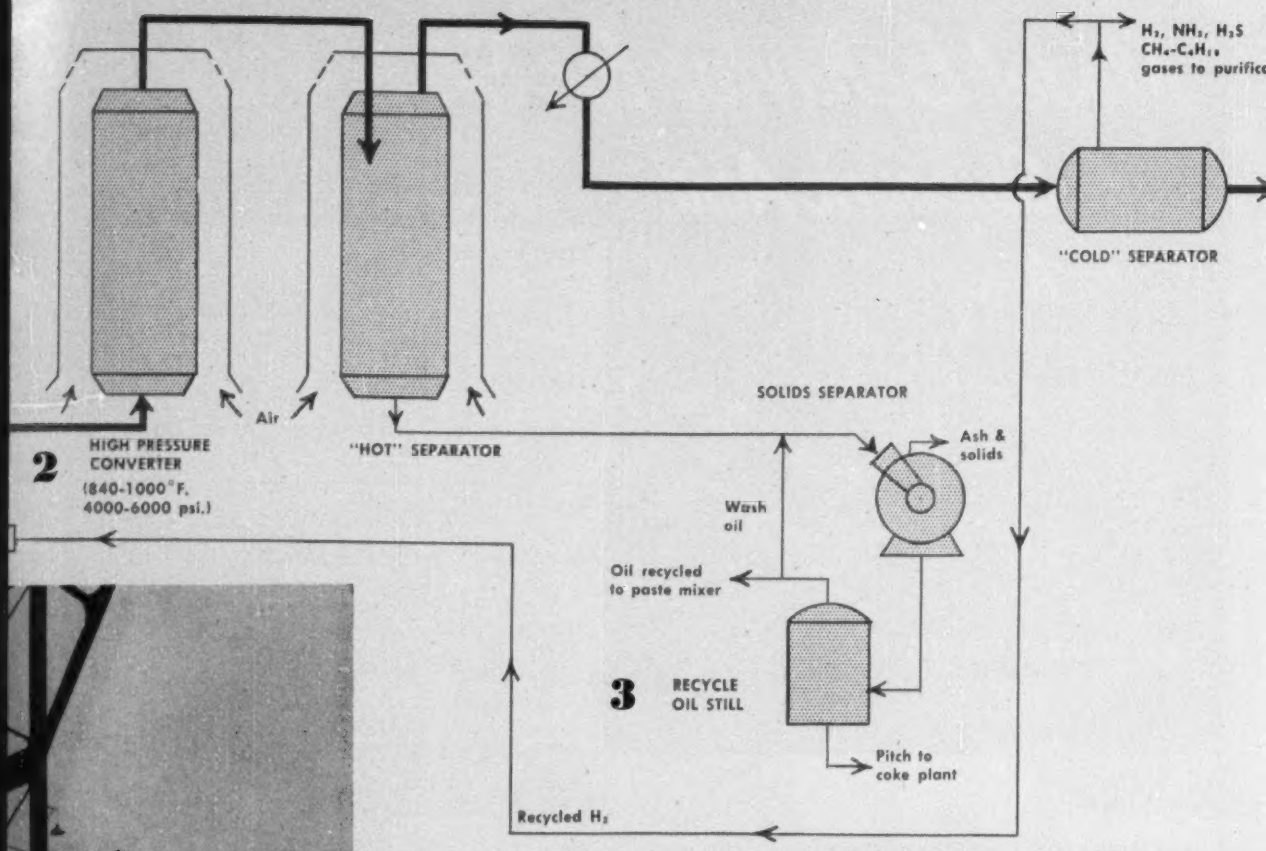
Here extraction separators first remove a mixture of benzene, toluene and xylene. Further solvent extraction splits the remaining stream into (1) a phenolic portion, (2) a hydrocarbon portion and (3) an aryl amine and nitrogen heterocyclic portion. The various aromatic products obtained by distilling these portions, are shown in the accompanying flowsheet.



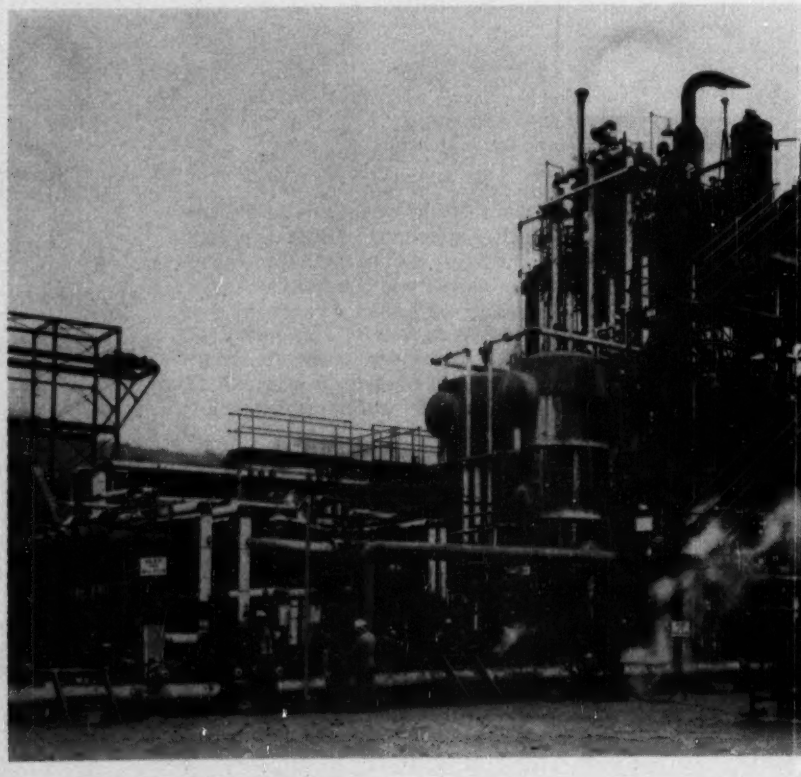
1



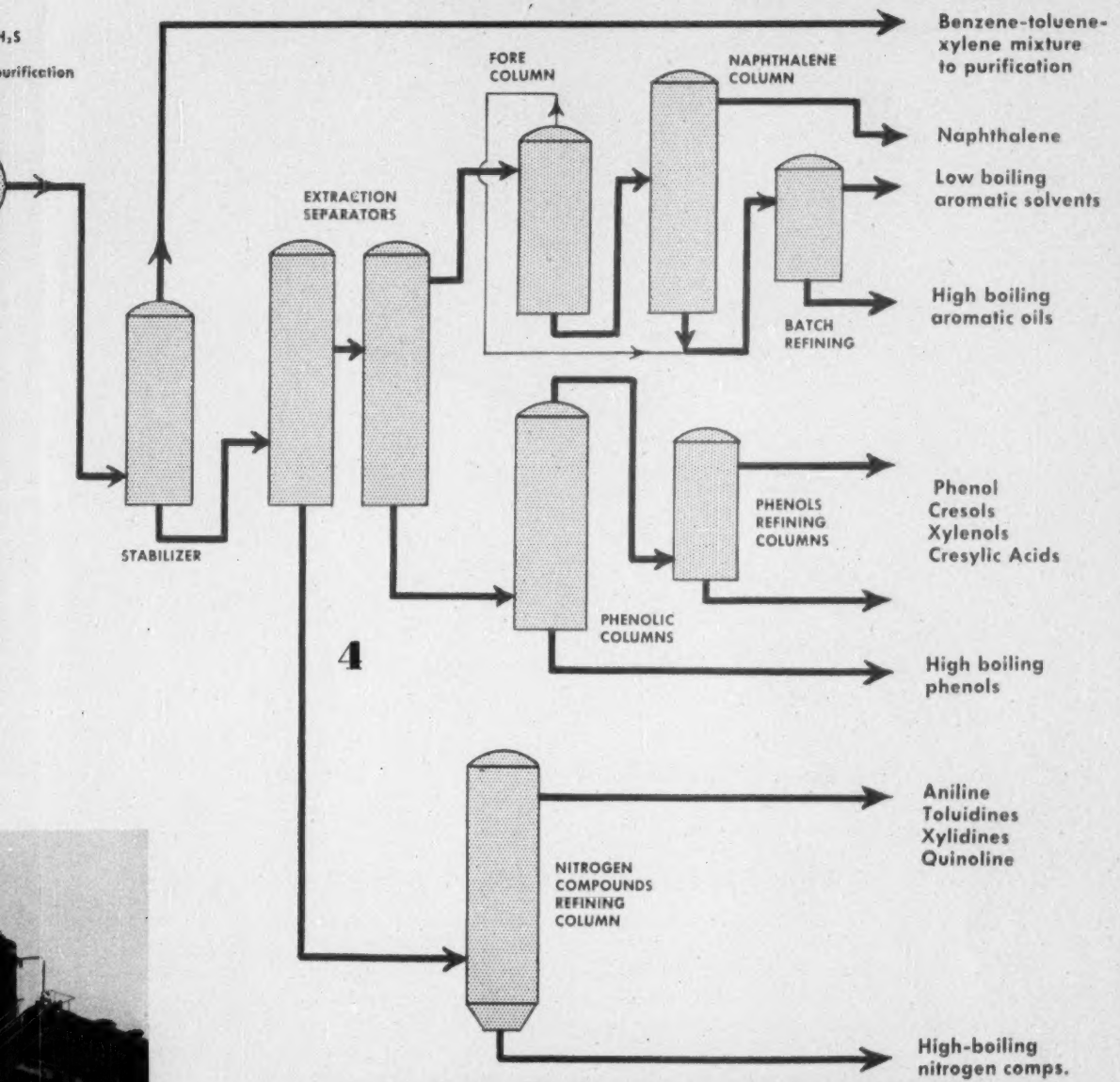
2 High pressure hydrogenation equipment. The coal-oil paste is reacted with hydrogen in the center converter, producing hydrogenated

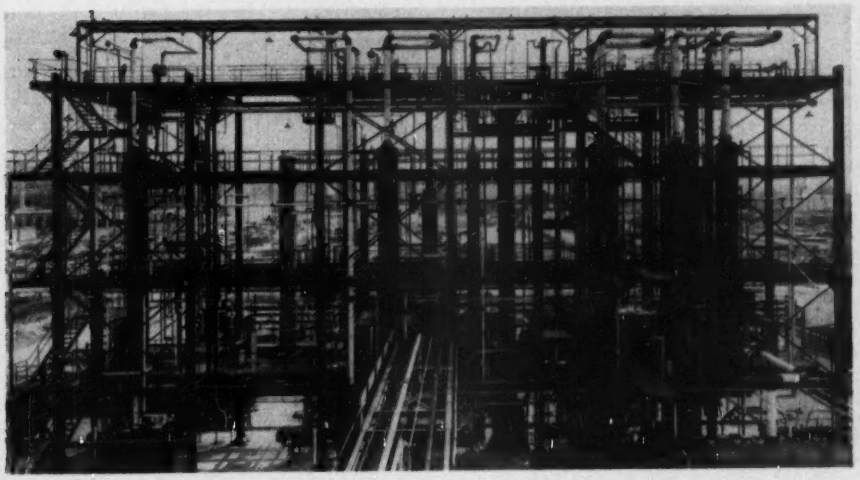


aromatic chemicals.

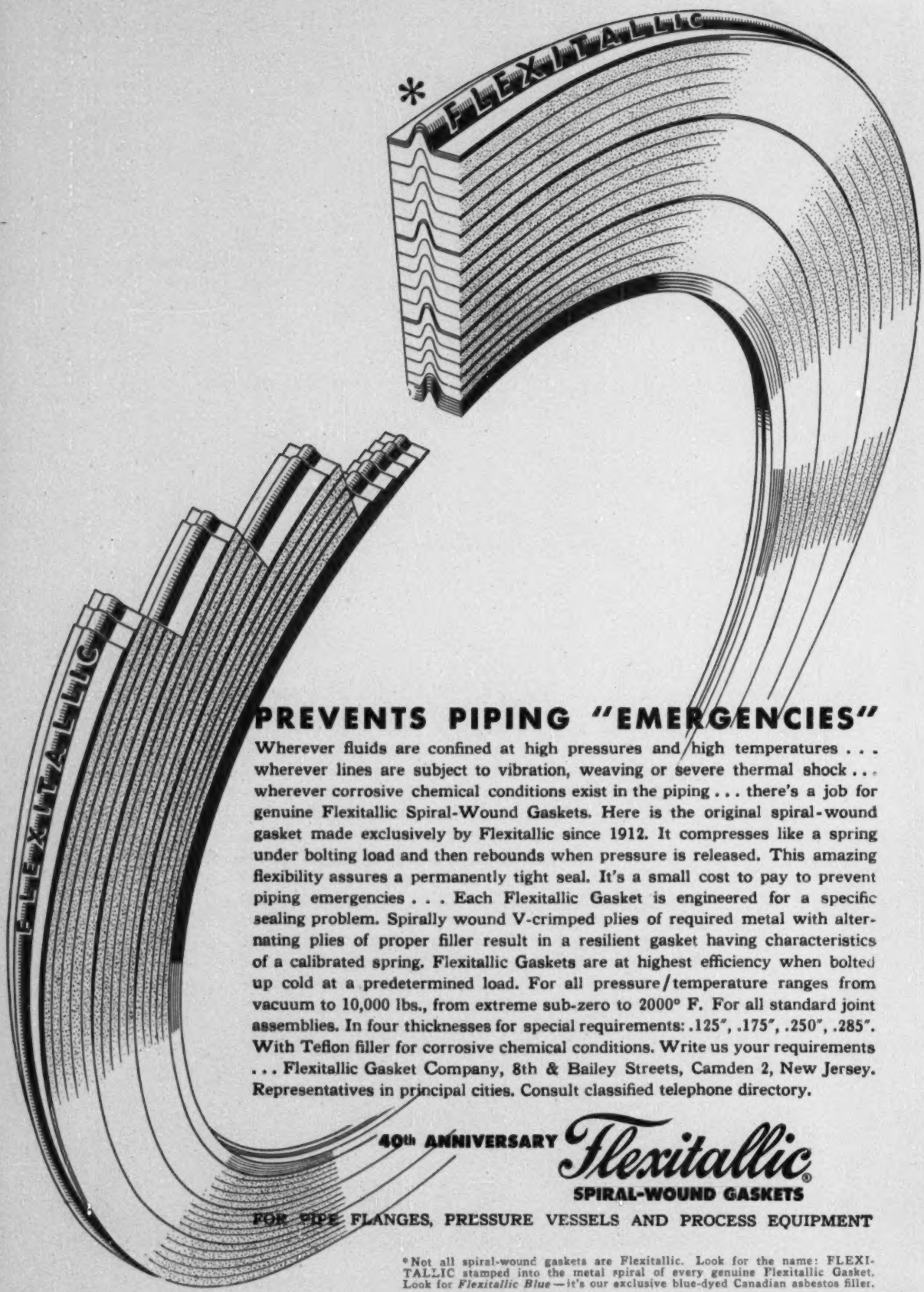


3 Recycle oil still separates liquid from "hot" separator into recycle oil and pitch.





4 Chemicals separation unit where crude products are refined into aromatic chemicals.



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Wherever fluids are confined at high pressures and high temperatures . . . wherever lines are subject to vibration, weaving or severe thermal shock . . . wherever corrosive chemical conditions exist in the piping . . . there's a job for genuine Flexitallic Spiral-Wound Gaskets. Here is the original spiral-wound gasket made exclusively by Flexitallic since 1912. It compresses like a spring under bolting load and then rebounds when pressure is released. This amazing flexibility assures a permanently tight seal. It's a small cost to pay to prevent piping emergencies . . . Each Flexitallic Gasket is engineered for a specific sealing problem. Spirally wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult classified telephone directory.

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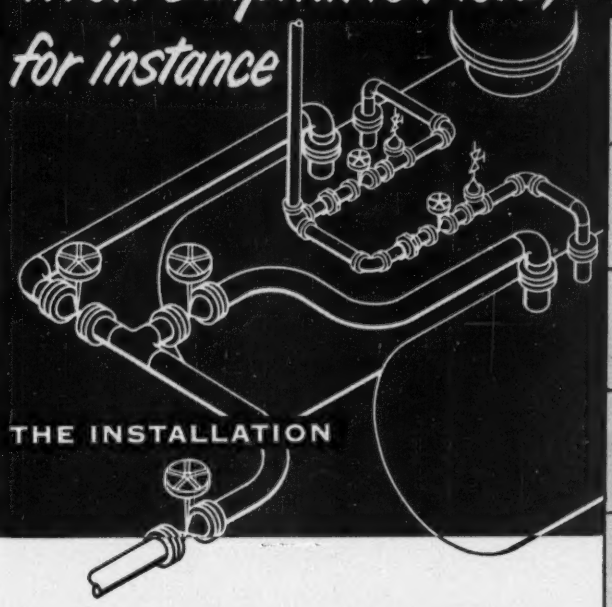
FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name: FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

Model Behavior for Steel Valves

...on Sulphuric Acid, for instance



At a leading Gulf Coast lube oil plant, using Crane steel valves on lines to concentrated sulphuric acid storage and blow cases.

VALVE SERVICE RATINGS

SUITABILITY: Giving full satisfaction

FEATURES: Compact bolted-bonnet design

MAINTENANCE COST: Routine service only needed

SERVICE LIFE: In lines more than 2 years

OPERATING RESULTS: Safe control of acid—no loss

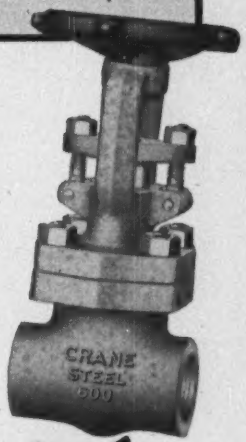
AVAILABILITY: Catalog item—No. 3607X

THE CASE HISTORY

Valves formerly used in this service showed severe corrosion a few months after installation. Both stems and seats were affected, with early leakage resulting. Longest life of any of these valves was less than one year.

Replacement was made more than 2 years ago with Crane No. 3607X steel gate valves. By effectively sealing against atmospheric condensation, the deeper Crane stuffing box prevented dilution of acid and resultant stem corrosion. Wider seating surfaces give Crane valves higher resistance to seat corrosion and leakage. They're still in service; show no loss of efficiency. That's the result of thrifty buying—when quality is the first consideration.

THE VALVE



You'll find big valve features in these Crane 600-pound bolted bonnet, small steel gates. They fill every need for quality, compact design, maximum strength with no excess weight. Easy to use; easy to service. Sizes, ½ to 2 in.; screwed, flanged, or socket-welding ends. See your Crane catalog or your Crane Representative.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

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Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

First in the Field

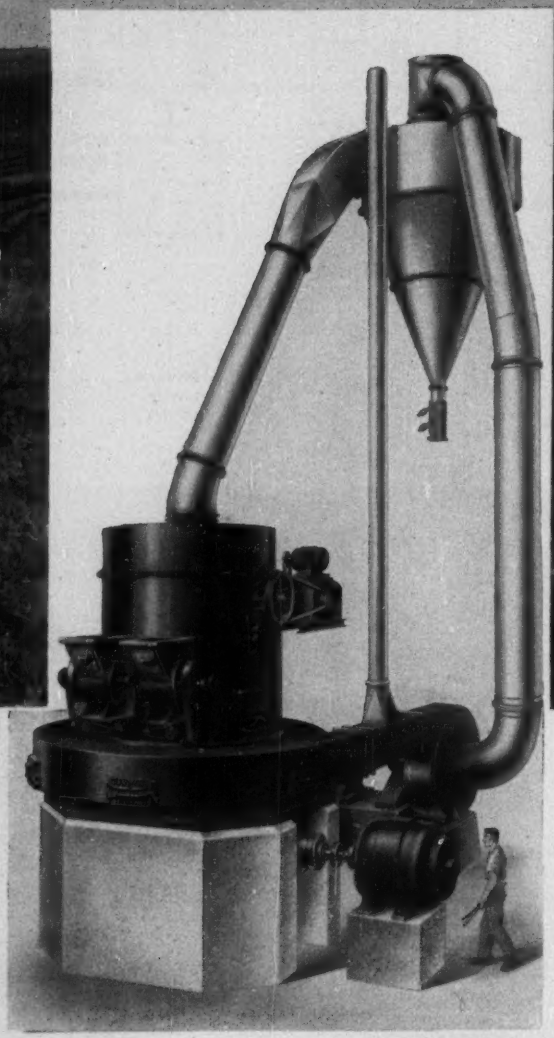
for

Grinding PHOSPHATE ROCK

•

RAYMOND ROLLER MILL

SINCE 1887



THE key to economy in operation and uniformity in production for grinding phosphate rock from all types of deposits is the Raymond Roller Mill. Its leadership has been maintained year after year by continuous improvements in design and construction to keep pace with the needs of the industry.

Raymond Mills are noted for their ease of fineness adjustment and consistent finished products at any fineness specification. Another advantage of great importance in these days of high building costs is the simple and compact arrangement of the equipment. The mill unit, collectors and connecting piping provide a flexible installation, requiring minimum floor space, which can be arranged to fit practically any plant layout.

Roller Mills are equally efficient in handling a great variety of chemicals, non-metallic minerals and manufactured products. Available in sizes to meet capacity requirements of small and large plants up to 30 tons or more per hour of finished material.

RAYMOND SUPER ROLLER MILL Equipped with Automatic Feeders and Whizzer Separation. Very economical for large tonnages of 10 to 30 tons per hour.

For complete details, ask for Raymond Catalog #69

COMBUSTION ENGINEERING, INC.

1311 NORTH BRANCH ST.
CHICAGO 22, ILLINOIS

Raymond Division

SALES OFFICES IN PRINCIPAL CITIES

GUIDED TOUR CONTINUED

YOU AND YOUR JOB

$10-50,000-a-year "Freshmen" **258**

CORROSION FORUM

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Graduate into an executive.

Here's how AMA trains executives. You can pattern your own development on some of their tested methods (*You & Your Job*).

Ag chemicals look far ahead.

And well they might, too, for more people and less farm land dictate more and better use of ag chemicals (*Economics*).

What's new in amyl alcohols.

Now, at last, you can get synthetic amyl alcohols with 95 percent primary isomers—in tank car lots (*Products News*).

New ways to get acetic acid.

Publicker dehydrogenates alcohol to acetaldehyde, then oxidizes. Celanese reacts carbon dioxide with methanol (*Tomorrow's Technology*).

AND—Index of Advertisers precedes your Reader Service section inside the back cover.

You'll find chemical engineers in practically every crop of these . . .

$10,000-50,000-a-Year "Freshmen"

Here's how the American Management Association trains executives. You can pattern your own development on some of their methods.

Ten years from now somebody's going to write a report summing up the results of the current revolution in management. In its simplest terms, the new thinking goes something like this: In corporate life today, knowing your business from a to z isn't enough—you also have to know the science of management and the art of handling people. That sounds like a simplification ad absurdum, yet a few of industry's top spokesmen today are "pooh-poohing" management training programs by saying that you become a successful manager by knowing your industry—whether it be chemicals, cars or cabbages. The fact is that knowing your industry is only half the battle and the traditional road of technical education plus experience leading to management has now been replaced by technical education plus technical experience plus management education.

The result is that managers who never heard of Frederick Taylor are now flocking back to school in droves, frankly infatuated with the idea of adding a new school tie to their wardrobe. The outstanding leader in this move to make management erudite is the American Management Association, largely through the medium of its Management Course, an intensive program which spells out the fundamentals of modern management methods in five weeks of discussion, lectures, clinics and reading.

The course is given in four basic units plus a fifth devoted to sharing on-the-job experiences. "Students" attend both formal lectures and small group meetings from 9 to 5, five days a week.

The course began in 1951 with a pilot group of 85 registrants; this year there were 2,300 executives signed up at last count and registrations were coming in at a rate of 40 a week.

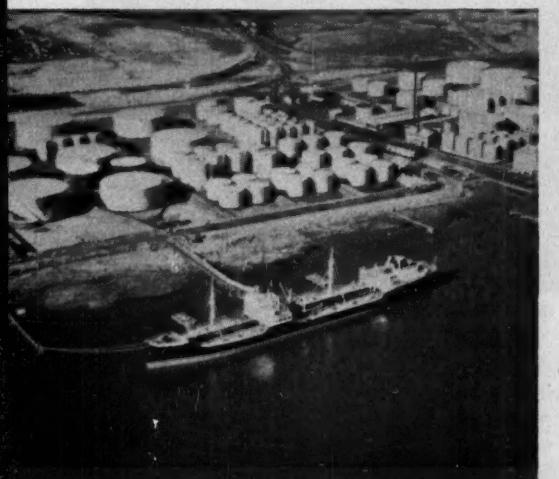
The reasons for this outstanding success are two: (1) obviously, the course is tailor-made to fill a pressing need; and (2) AMA has at its disposal the best business brains in the country. Top companies are glad to send their best men to lecture AMA groups just as they encourage their technical men to address AIChE and other technical groups. The "floating faculty" system as it is called, works this way: Monsanto's comptroller, for instance, may come into a typical class session of 45 course registrants with a "hypothetical" problem. He'll present all the facts and figures to the class which will then divide up into small groups. The men in these groups will discuss the case and come up with a solution. After that, the groups

This is the third and last of a series of three articles on executive development. The first, dealing with self-administered programs, appeared in February (pp. 248-260). The second, illustrating the consultant's approach appeared in September (pp. 284-298).

yours to use...

HOUSTON

CORPUS CHRISTI



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In 5 great markets General American offers you complete bulk liquid storage terminal facilities with no capital investment on your part. You use modern facilities, pipelines, manifolds, blending equipment. You have complete privacy.

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At the Ports of New York and New Orleans there is high-speed canning, drumming and barreling equipment—yours to use.

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TANK STORAGE TERMINALS GENERAL AMERICAN

GROUP SESSION: Top and middle executives swap experiences and teach themselves through the medium of conference leadership.

reassemble and the chairman of each presents his group's solution. Then the comptroller reveals that the problem was an actual one and he tells the class how Monsanto solved it. Sometimes a group comes up with a better solution than the actual one and the executive in question will have something to take back to his company. This is problem solving at its best; it's one of the most successful techniques for developing managers.

It is just this sort of cross-fertilization that has made the AMA course such a howling success. Today, a chemical executive finds an answer to a shipping problem from a railroad executive; tomorrow the railroad man finds the answer to a corrosion problem from the chemist.

The small, independent businessman, doing a gross of $250,000 a year finds himself almost in a new world as he sits down with the

Basic Outline of the AMA Management Course

In spite of the current activity in management development, most chemical engineers are not yet ready for company-sponsored programs. If you'd like to get a head-start by undertaking your own program*, here is one of the best frameworks you'll find anywhere.

Unit I—Basic Principles, Skills and Tools of Management

A. Definition and Scope of Management
1. What Management Is
2. Scope and Nature of the Responsibilities
3. A Management Formula

B. Historical Development of the Science of Management
1. Significant Personalities and Events in the Management Movement
   a. The pioneers
   b. Early growth of scientific management
   c. Development of the principles of management
   d. Change in emphasis
2. Current Forces and Influences in the Management Movement
   a. Universities and colleges
   b. Associations
   c. Consultants

C. Philosophies and Creeds of Management
1. Need for Clear-Cut Basic Attitudes
2. Individual and Company Creeds of Management

D. The Skills of Management (Abilities)
1. In Terms of Broad Categories
   a. Maintaining the economic health of an organization
   b. Integrating the viewpoints of people and functions
   c. Instilling the service motive
   d. Making an organization dynamic and adaptable
   e. Providing human satisfactions in work output and relations
2. In Terms of Specific Skills
   a. Forecasting
      (1) Interpreting data
      (2) Evaluating information and sources
   b. Planning
      (1) Setting objectives, procedures and responsibilities
   c. Organizing
      (1) Determining, dividing, assigning responsibilities and authority
      (2) Establishing chain of command
      (3) Determining span of control
      (4) Other guiding principles
   d. Selecting staff
   e. Selecting equipment, materials, facilities
   f. Establishing and maintaining controls
   g. Reviewing and appraising
      (1) Appraising individuals
      (2) Appraising operations
   h. Establishing rewards and incentives
   i. Communicating
      (1) Expressing oneself orally and in writing
      (2) Conducting interviews
      (3) Conducting conferences and meetings
      (4) Teaching
      (5) Securing participation
   j. Organizing one's own work
   k. Mental facility
   l. Making decisions
   m. Commanding
      (1) Supervising and developing others
      (2) Coordinating and integrating
      (3) Morale building
      (4) Disciplining

E. Tools of Management
1. Forecasts on
   a. Business outlook
   b. Product market
2. Research in
   a. Physical resources
   b. Human resources
3. Plans
   a. Policies
   b. Formal program
   c. Budgets
4. Standards of Performance
   a. Engineered and non-engineered standards
   b. Quantity, quality, cost and time standards
5. Procedures
   a. Standard practice manuals
6. Personnel Selection Techniques
   a. Resumes
   b. Tests
   c. Interviews
7. Organization Structure
   a. Position specification
      (1) Position description
      (2) Position qualifications
   b. Organization charts and manuals
   c. Activity analysis
8. Personnel Utilization Techniques
   a. Training and education
   b. Work simplification
9. Controls
   a. Cost systems
   b. Financial statements
   c. Break even charts
   d. Return on investment analysis
   e. Work measurement
   f. Internal auditing
   g. Statistics
10. Appraisals
   a. Management audits
   b. Progress reports
   c. Conference, group, multiple appraisals
   d. Rating systems
11. Rewards and Incentives
   a. Job analysis and evaluation
   b. Income surveys
   c. Financial and non-financial incentives
12. Communication Systems
13. Executive Time Budgets

F. Qualifications of the Manager
1. Personal
   a. Health and physical make-up
   b. Maturity
   c. Character
   d. Mental attitude and facility
   e. Motivations
   f. Powers of expression
   g. Habits
2. Technical or Operational
   a. Knowledge
   b. Experience
3. Managerial
   a. Understanding of responsibilities, obligations, environment
   b. Philosophy of management
   c. Knowledge of the science of management
   d. Management skills

G. Preparation for Management
1. What should be the Preparation
2. What Is Now Being Done and Is Available
3. How Effective Are Those Programs

* Most libraries, publishers and schools can help you get together a good reading list. The Harvard Business School, Baker Library, publishes an especially fine "Executive Reading List."

Despite cleanliness and efficiency of a midwest firm's Plastic Division, shown above, there was "dirty work" afoot in the hydraulic systems of the injection molding machines. Division superintendent (left) and A. L. Seabaugh, of Standard Oil, came up with a solution.

Stops "dirty work" in hydraulic units

● A midwest company became increasingly aware that hydraulic oil performance in its fourteen injection molding machines was not all that it should be. Formation of oil deposits not only made frequent cleaning of filters necessary but posed a threat to efficient operation of the hydraulic units.

A Standard Oil lubrication specialist recommended STANOIL Industrial Oil, a top quality product of exceptionally high stability and containing necessary additives to prevent corrosion and oxidation troubles.

Throughout six years of continuous hard use, STANOIL has provided clean operation. It has not been necessary to replace any of the original fills of STANOIL, and only a small amount of make-up oil has been needed. Where filters previously had to be cleaned at least four times a year, they are now cleaned once each year. Hydraulic operation has been efficient and reliable.

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Industrial Oil

You can rely on STANOIL to give you the same clean, dependable service not only in hydraulic units but in a wide variety of equipment. You can get the help of the Standard Oil lubrication specialist serving your section of the Midwest by phoning your local Standard Oil office. Or, write: Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

What's YOUR problem?

A. L. Seabaugh, working out of Standard's Chicago office, is the lubrication specialist who helped this midwest firm gain both operating and maintenance benefits through use of STANOIL in hydraulic units.

Located throughout the Midwest is a corps of specially trained, experienced Standard Oil lubrication specialists, ready to give you prompt, on-the-spot help with lubrication in your plant. Their broad background of practical experience, plus their thorough training in Standard Oil Lubrication Engineering Schools, is yours for the asking. Simply phone your nearest Standard Oil Company office. The lubrication specialist will call without delay. He has a complete line of petroleum products to offer, including such outstanding lubricants as:

SUPERLA Greases — Available in a wide range of consistency grades and in both lime-soap and soda-soap types. SUPERLA Greases cover a wide range of operations. These efficient products are comparable in quality with the highest type of special greases.

STANOLITH Greases — Because these unique lithium soap products possess the heat resistant properties of soda-soap greases and the water resistant properties of lime-soap greases, they offer a solution to lubrication problems caused by the presence of both heat and water.

STANDARD OIL COMPANY

STANDARD (Indiana)

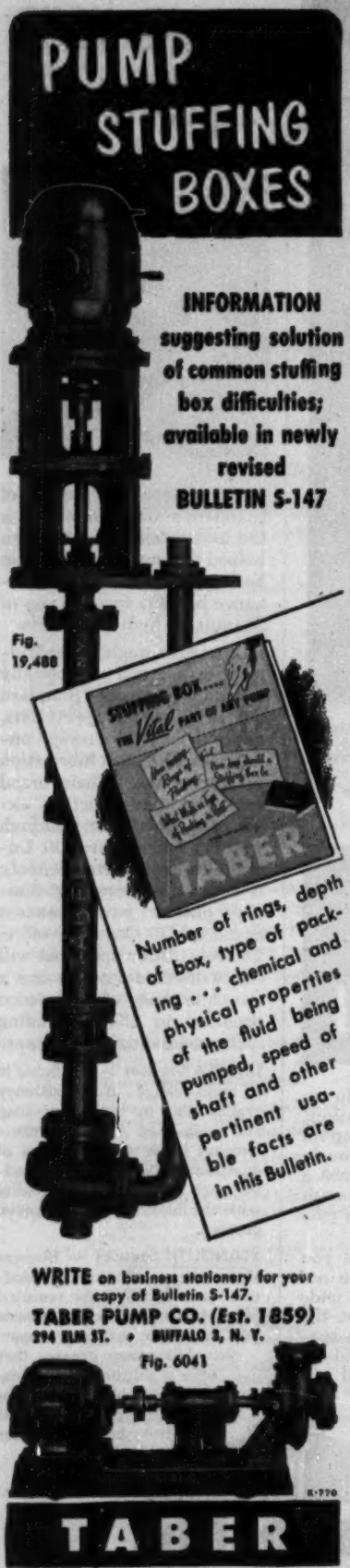
PUMP STUFFING BOXES
INFORMATION suggesting solution of common stuffing box difficulties; available in newly revised BULLETIN S-147
Fig. 19,488
STUFFING BOX.... the Vital PART OF ANY PUMP
TABER
Number of rings, depth of box, type of packing . . . chemical and physical properties of the fluid being pumped, speed of shaft and other pertinent usable facts are in this Bulletin.
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Fig. 6041
E-770
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Du Ponts, the Dows and the U. S. Steels. He learns about controls; he learns that there are over 40 associations dealing with management alone and that many of these can help him in his job; he learns how to conduct conferences. But most of all he thinks about the job he is doing and he thinks about ways to improve it. As Larry Appley, president of the AMA and guiding spirit of the course says: "Responsible men cannot get together without becoming concerned about the job they're doing and going back to do a better job."

The pace of the course is a rugged one as Bill Kushnick, its director, warns every applicant. Lunches and breaks are short and few, and full-time course leaders (who are AMA personnel) keep the registrants on the go from 9 to 5 with formalized lecture sessions as well as the informal small group sessions. When a man isn't trying to absorb years of management evolution in less than an hour, he's contributing his particular specialized knowledge to a problem-solving session or a small group discussion. In so doing, he's developing his conference leadership abilities. Evenings the "students" are free to whittle at some of the mountains of selected reading that has been suggested and is available in AMA's library. Some of the men continue their daytime discussions in their hotel rooms. The breakneck pace is also tempered by the fact that informality is the rule. Everyone is known by his first name and carries a large nameplate as well as a badge to identify him. There are no textbooks, rules or other academic trappings. The philosophy, according to Kushnick, is to keep the course as current as the day's newspaper by bringing operating executives in as guest faculty to talk about their company's current problems and what's being done about them.

Visual aids are used heavily in the course presentations. These are supplied by the instructor and often are prepared by his company.

Each one-week unit of instruction is complete in itself and the subject matter follows a specific outline. Each registrant is given a personal notebook for each of the units. The notebook contains excerpts from the best literature dealing with the subject matter of that particular unit.

For instance, in Unit One which deals with "Basic Principles, Skills and Tools of Management," a typical excerpt dealing with the scope and nature of the responsibilities of management reads like this:

"The first step was savagery, in which the leader takes the point of view that the other fellow is his enemy and is to be destroyed.

"The second step in the evolution of management attitude is slavery—the other fellow is to be conquered and put at my service.

"The third is servitude—the other fellow is to serve me for a consideration and ask no more.

The fourth is welfare—the other fellow should be helped up when down, without too much concern for what got him down.

"Number five is paternalism—the other fellow should be cared for and I will decide to what extent.

"The sixth step is participation—the

Basic Outline—Unit II

Planning and Controlling

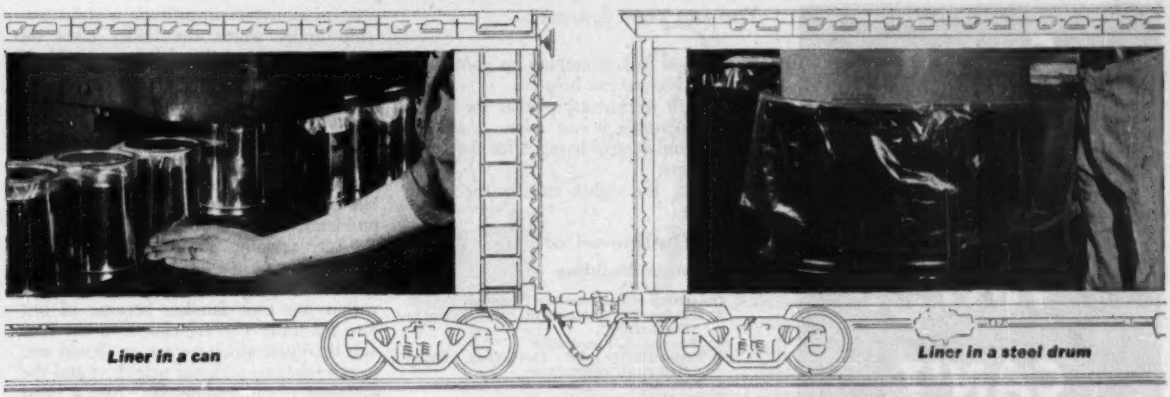
A. Planning and Control—the Executive's Everyday Job
  1. The Management Cycle
  2. Functions and Scope of Planning and Control
    a. Engineering
    b. Manufacturing
    c. Marketing
    d. Personnel
    e. Finance
    f. Corporate affairs

B. Planning
  1. Why Plan?
  2. Planning Techniques
    a. Determining goals
      (1) Corporate objectives
      (2) Policies
      (3) The economic climate: forecasting; market research
      (4) Operating plans and programs
    b. Designing the approach
      (1) Organization
      (2) Systems, procedures, and methods
      (3) Standards
      (4) Budgets and schedules
  3. What's Wrong with Planning?
    a. Shackles or support
    b. Danger of bureaucracy
  4. Planning That Works

C. Control
  1. Its Real Meaning
  2. Control Techniques
    a. Measuring performance
      (1) General and cost accounting
      (2) Production control and inspection
      (3) Personnel measures
      (4) Management control data
    b. Appraising results
      (1) Ratio analysis and statistical methods
      (2) Check lists and rating scales
      (3) Quality control
      (4) Financial audits
      (5) Management surveys and studies
  3. Pitfalls
    a. The case of the missing yardsticks in management
    b. Hazards of judgment
  4. Remedies

D. Feedback—Link Between Planning and Control
  1. Its Significance in Business Practice
  2. Feedback Techniques
    a. Reports
      (1) Graphic presentation and tables
      (2) How to make reports more interesting
      (3) Distribution of reports
    b. Other communications
    c. Consultation and management research

E. Planning and Control in Action
  1. The Human Side
    a. Motivation, not regulation
    b. Participation
  2. Organizing for Planning and Control
    a. No specific organizational provisions
    b. Separate planning organization
    c. Separate control organization
    d. Deliberate and systematic coordination of the two
      (1) Centralization
      (2) Decentralized arrangement
  3. Costs Versus Benefits
  4. How to Introduce Planning and Contro
  5. How to Keep it Alive; How to Strengthen it; How to Live with it Profitably



Liner in a can

Liner in a steel drum

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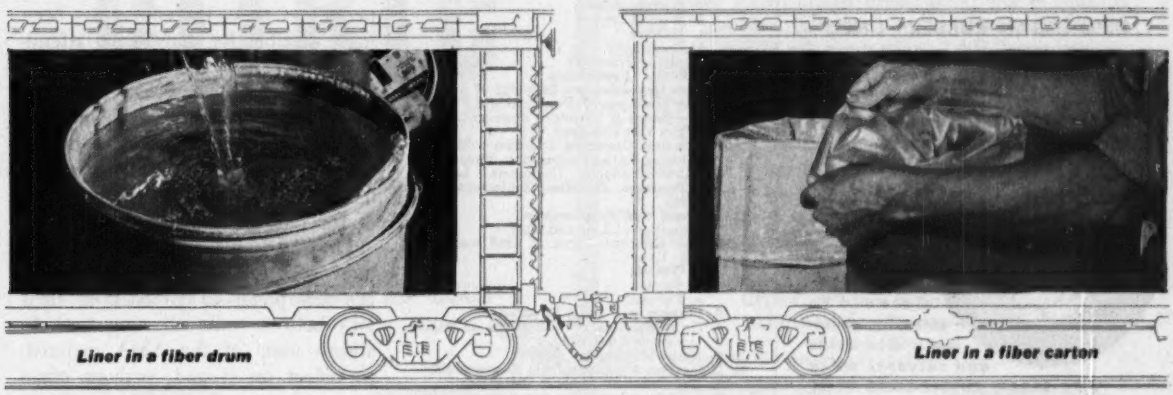
for your difficult products gives you these four shipping methods



Liner in a fiber drum

Liner in a fiber carton

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Liner in a steel drum—corrosives, acids, adhesives, all "come clean" from the container. 100% product recovery. No drum-cleaning costs.

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other fellow has something to contribute to my efforts and can help me.

"Seventh is trusteeship—that for which I am responsible is not mine. I am developing and administering it for the benefit of others.

"Finally, the eighth step in the evolution of management attitude is statesmanship—under which the leader takes the position that the other fellow is capable of being far more than he is, and it is the leader's responsibility to help him develop to his fullest potential.

"... statesmanship in management may seem like a lofty and impractical ideal—a fine sentiment to be used in speeches, but something apart from daily practical problems.

"But, actually, however, I believe we must make this our very real goal. It is this spirit of helping others which we practice within our own families because of our love for those who are closest to us. It is also the spirit which we use, or should use, in our relations with our neighbors and the members of our community. And it must become the spirit in which we deal with all the people we associate with in the business world. Our objective, in each case, must be a selfless one—one of helping each individual to realize his full potential as a human being."[1]

Basic Outline—Unit III

Organization Building

A. **Objectives of Organization Planning**
   1. Relationship of Organization Planning to Management
   2. Meaning of Organization
   3. Responsibility for Developing Sound Organization Structure
   4. Approaches to Organizational Analysis
   5. Depth of Organization Planning
   6. Consequences of Poor Organization
   7. Benefits of Sound Organization
   8. Relationship to Other Management Techniques
   9. Organization Goals and Basic Management Philosophy

B. **Principles of Organization**
   1. Ideal Plan and Program
   2. Theory and Practice
   3. Ten Principles of Organization
      a. Objective
      b. Specialization
      c. Coordination
      d. Authority
      e. Responsibility
      f. Definition
      g. Correspondence
      h. Span of control
      i. Balance
      j. Continuity
   4. Applying Principles
   5. Informal Organization

C. **Factors Governing the Grouping of Activities**
   1. Top Management Functions and Programs—Board of Directors, President, Executive Vice President
   2. Principal Operating Functions—Manufacturing, Sales, Engineering, Finance, etc.
   3. Other—Products, Customers, Location, Processes, Facilities, Equipment, Time, etc.

D. **Line and Staff Relationships**
   1. Definition of Line and Staff
   2. The Different Types of Staff and Their Uses
      a. General
      b. Special
      c. Personal
   3. Making Staff Work Effective
   4. Committees as an Alternative or Supplement to Staff Work
   5. Effect of Company Growth

E. **Delegation of Authority and Responsibility**
   1. The Different Types of Delegation
   2. Advantages and Disadvantages of Delegation
   3. Principles Governing Delegation
      a. Engineering considerations
      b. Administrative expenses
      c. Personality
   4. Making Delegation Effective
   5. Decentralization
   6. The Short Span of Control Versus the Short Chain of Command

F. **Establishing and Formalizing the Organization Structure**
   1. Developing a Basic Corporate Plan
   2. Steps in Developing an Organization Manual
   3. Charts—Kinds, Uses, Limitations
   4. Job Descriptions
   5. Job Specifications
   6. Performance Standards
   7. Appraisal Records
   8. Publication, Maintenance and Use of the Manual
   9. Gaining Acceptance to Organization Change
   10. Maintaining Morale During Periods of Change

G. **Continuous Refinement of Organization**
   1. A Balanced Approach
   2. Planning Specific Projects
   3. Analysis of Functions
   4. Revision of Organization Structure
   5. Participation and Concurrences
   6. Introducing Changes

H. **Controlling the Organization**
   1. Fixing Responsibility for Control
   2. Periodic Review by Operating Units
   3. Audit and Follow-up

I. **Some Major Conclusions**
   1. Trends in Management
   2. Common Problems Relating to Organization
   3. Basic Considerations in Organization Building
   4. "Take Home" Points on Organization
   5. A Few Warnings in Applying Organization Principles
   6. Planning a Program o Organization Improvement

Since the heavy work loads of most executives make it difficult for them to be away from the office for long periods of time, the course has been made flexible for convenient attendance. The four units of instruction may be taken in consecutive weeks or over a period as long as twelve months. The applications clinic may be attended within the period of a year following the registrant's completion of the four basic units.

Only 6-7 percent of the registrants take the 4 weeks consecutively, the rest prefer to go back to their jobs betwen units allowing time to absorb some of the AMA material, to reflect on it and, perhaps come back with some challenging new problems. For these reasons, Appley recommends stretching the units out.

Appley also suggests that applicants for the course should be in the upper third of the management group in order to have the maturity and experience to contribute to the group sessions. This rule is flexible, though, since no business is too small to be accepted. One company with an operating staff of six men and doing a gross of $150,000 a year sent one of its men; another much larger company has so far sent its president, 12 staff officers and 11 executives. This year there are 45 additional registrants from this company.

Cost of the course is $800, or $650 without unit five. The fee includes tuition, course materials and luncheons. Here is the AMA's description of the subject matter of the course:

Unit 1—Basic principles, skills and tools of management
Aims, Responsibilities and Scope

Versatile

is the Word for

CITRIC ACID

Check These Industrial Uses

For many years this non-toxic acid has served as the leading organic acidulant in foodstuffs ...beverages, candies, jellies, desserts. Now, more and more industries are finding Pfizer Citric Acid and its derivatives ideal for a variety of processes far-removed from the "kitchen."

Take metal finishing for example. Because it removes oxide films with a minimum loss of virgin metal, you'll find Citric Acid used in polishing and cleaning processes. Di Ammonium Citrate is finding increasing use in the removal of iron contamination from stainless steel and rust scale from iron surfaces.

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Since it contains one hydroxyl and three carboxyl groups, Citric Acid as an intermediate for organic synthesis offers many interesting possibilities. And, esters of Citric Acid...several of them marketed commercially by Pfizer...offer the plastics industry non-toxic plasticizers with a range of desirable characteristics.

These varied applications may suggest mild, versatile citric as an acid or intermediate in your processing. For additional information, write:

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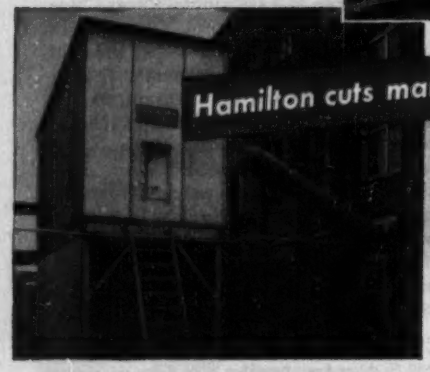
How Can Pangborn Dust Control Save You Money?

Here's how these firms saved with Pangborn:

Nalco salvages $50 a day

National Aluminate Co., Chicago, Ill., uses seven Pangborn Dust Collectors to trap valuable chemical dusts at the source . . . saves well over $50 a day. Nalco reports that reclamation savings "have already paid for the Pangborn Collectors."

Hamilton cuts maintenance $100 a month



Hamilton Rubber Co., Trenton, N. J., installed Pangborn Dust Control to improve employee morale and reduce plant housekeeping. Pangborn did this and more—savings in maintenance, housekeeping, and machine repairs give Hamilton a bonus of $100 a month!

THE case histories above tell our story. Whether you want to increase profits by reclaiming valuable dust or cutting maintenance costs . . . whether you're interested in improving working conditions or community relations . . . whether your needs are big or small, Pangborn will solve your dust problem. For information on how Pangborn can save you money, mail the coupon below now!

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

Pangborn DUST CONTROL

STOPS THE DUST HOG from stealing profits

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of Management; a Management Formula; Current Philosophies and Creeds; Specific Skills the Manager Needs; Managerial Tools and Their Uses; Qualifications and Preparation for Management.

There is a rapidly growing realization that management is an activity in itself, unlike any other activity, and that it requires certain basic attitudes, concepts, skills, tools, qualifications and preparation. To give management people a clear, concise and vivid understanding of the nature of their activity, the first unit reviews the development of the science of management, outlines current philosophies and creeds and defines management's aims, responsibilities and scope. Specific managerial skills and tools which are common requirements at all levels of executive responsibility are identified and defined; detailed explanation of them is left for later units.

Unit 2—Planning and Controlling
Establishing Objectives, Plans and Policies; Setting Standards of Performance; What to Control; Control Tools; Organizing, Introducing and Using Controls.

Basic Outline—Unit IV

Appraising Results and Taking Action

A. Appraising People
1. The Executive Function
2. Appraising Operations and Appraising People
3. Purposes of Executive Appraisal
4. Benefits of Planned Management Development
5. Functions of Employee Merit Ratings

B. Factors Facilitating Sound Management Development
1. Organization Clarification
2. Standards of Performance
3. The Management Climate
4. Introducing the Management Development Program
   a. Sponsorship and participation
   b. Pilot operation
   c. Let procedural details evolve
   d. Staff services
5. Follow-Through

C. Basic Considerations for the Appraisal Process
1. What to Appraise
   a. Present performance
      (1) Variations in approach
      (2) Appraising results and methods
   b. Personal qualifications
      (1) Evaluation methods
      (2) Appraising outstanding strength and weakness
   c. Future potential
   d. Recommended action
2. Who Appraises
   a. Individual's superior
   b. Multiple appraisers
   c. Group (conference) appraisal
3. Appraisal Techniques
   a. Essay reports
   b. Graphic rating scales
   c. Forced-choice
4. Frequency of Appraisals
5. Appraising—A Continuous Process
6. Psychological Tests in Appraising

D. The Executive Inventory

E. The Review and Audit

F. Guides for the Appraisers

G. Conducting the Post-Appraisal Interview
1. Importance of the Discussion
2. Aids for an Effective Interview

H. Taking Action for Improved Performance
1. Determining Nature of Action Required
2. Source of Action
3. Time Schedule for Action

I. Management Development Media

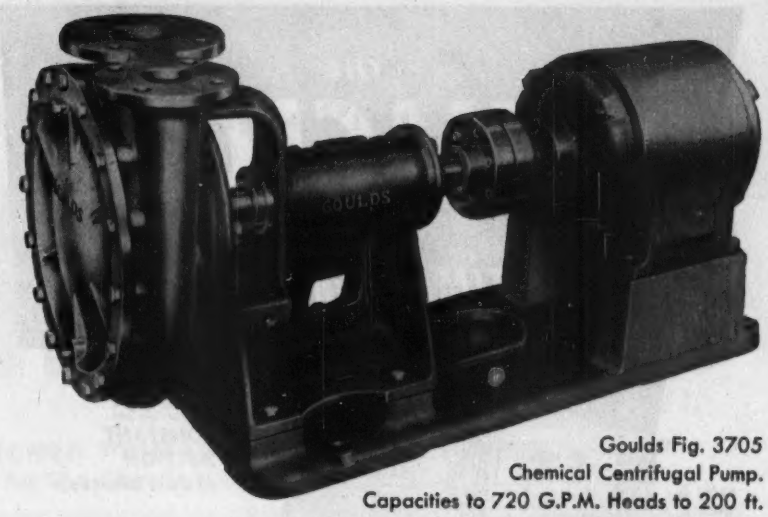
Building on the broad foundation developed in the first week, this unit deals with determining company objectives, how best to accomplish them, measuring operational results, and evaluating the lessons they contain. Planning techniques are presented first: policies, forecasts, programs, budgets and schedules; systems, procedures and methods; and standards and other operational yardsticks. Managerial controls are then considered: The design of a network of information that covers all corporate activities; and the role of accounting, production control, inspection, audits, and other performance measures. Also included are ways to make management reports more effective, and the essentials for organizing and introducing controls.

Unit 3—Organization Building
Principles of Sound Organization; Dividing and Grouping Activities; Line and Staff Relationships; Delegating Authority and Responsibility; Formalizing the Structure; Controlling the Organization.

Organization structure is the framework within which plans and controls must function. Management skill lies in the ability to provide the kind of framework in which individuals can work together as effectively as they can work alone. Explained in this unit are the basic principles of sound organization; considerations in planning what the company structure should be; types of organization structure that may be effective under various conditions; and methods of describing and controlling organization structure. The unit also is concerned with the governing principles and detailed problems involved in the division of activities, delegation of responsibility and authority, centralization and decentralization, span of control, line and staff relationships, personality interactions and the like. Work in this unit includes the preparation and use of organization charts, position descriptions and organization manuals along with similar tools of control.

Unit 4—Appraising Results and Taking Action
Methods of Appraising Executive Performance and Potential; Conducting the Appraisal and the Post-Appraisal Interview; Taking Action to Develop Individuals and Improve Their Performance.

Complete review of operational results requires review of the activities



Goulds Fig. 3705
Chemical Centrifugal Pump.
Capacities to 720 G.P.M. Heads to 200 ft.

Now available in these 8 different materials!

You know the Goulds Fig. 3705 as the pump that is saving chemical plants thousands of dollars in handling corrosive liquids such as acids and alkaline liquors.

You've asked if it could be supplied in materials other than stainless steel 316 and FA-20. Here's the answer:

You can now take your choice of these eight different materials:

1. Stainless steel 316
2. Stainless steel FA-20
3. Stainless steel 304
4. All iron
5. All bronze
6. Bronze fitted
7. All iron, stainless steel trim
8. All bronze, stainless steel trim

And you can take advantage of these four saving benefits:

a. **Long packing life and freedom from leakage**—Stuffing box on suction side of impeller means pressure is limited to suction head.

b. **Easy cleaning and inspection**—Suction and discharge connections in casing permit removal of casing cover and impeller without disturbing piping.

c. **Impeller clearance adjustable for wear**—By loosening and sliding end cap along shaft you expose locking collar on outboard ball bearing, permitting you to readily adjust impeller position.

d. **Low parts inventory** — Interchangeable parts permit you to keep inventories down and prevent excessive down-time.

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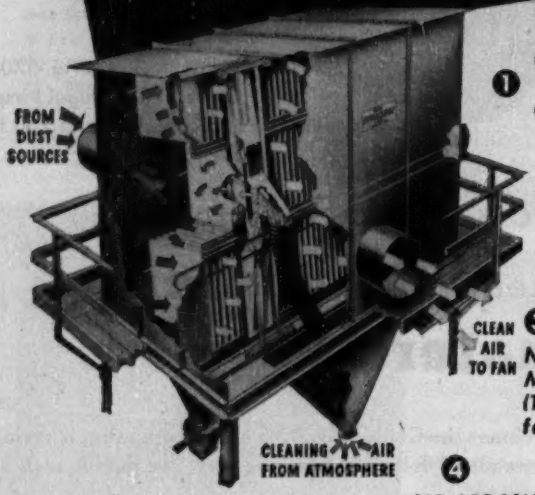
The ULTIMATE in Dust Filters



1 CONSTANT SUCTION at dust sources.

2 SELF CLEANING for continuous operation.

3 NO AUXILIARY MOTORS or BLOWERS (The main operating fan does the cleaning).

4 NO ABRASION of BAGS by the CLEANER.

5 LESS OVERALL HEIGHT and FLOOR SPACE.

HOW IT OPERATES

(a) Dust laden air is drawn in from the dust sources as indicated by the shaded arrows.

(b) It is diffused into the dust chamber by the baffle plate.

(c) It is then drawn through the fabric of the filter bags and is cleaned as shown by the clear arrows.

(d) Clean air passes out of the case and goes to the suction fan.

(e) Concurrently, the traveler moves back and forth across the dust wall registering successively with one bag at a time.

(f) The suction which exists in the dust chamber draws a blast of atmosphereic air through the bag in reverse directions and cleans that bag. (No shaking.)

Control your industrial dust better, for less — with the Sly Dynaclone. May we explain how?

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SLY PIONEERS & LEADERS in INDUSTRIAL DUST CONTROL

of each member of the management team. These appraisals are the chief means of reducing the gap between desired goals and actual performance. The subject matter of Unit 4 covers ways of appraising an individual executive's operating results, his methods of attaining those results, his personal qualifications and his potential for promotion. It includes practice in making the appraisal and in conducting the post-appraisal interview. Patterns for the action and development that should follow the individual appraisals are considered in full.

Unit 5—Applications Clinic
Exchange of Applications Experiences; Extending and Sharpening Applications; Review of Course Principles, Skill and Tools.

Each of the four instructional units presents specific principles and tools which can be applied in solving management problems more successfully. At the applications clinic, registrants exchange their experiences in putting the course into practice, thereby gaining help and stimulus for extending and sharpening applications.

REFERENCES

1. Humphreys, H. E., Jr., "Management's Responsibility and Attitudes," Report Southern Industrial Relations Conference, 1951, pp. 21-22.

CHANGING JOBS

. . . *Some Advice*

Some good tips for high-level people on changing jobs are given by Perrin Stryker, writing in the August, 1953, issue of Fortune.

He points out that top people are often "just as stupid about selling themselves as a youngster trying for his first job." Stryker maintains that management consultants often carry on stealthy man-hunts, on behalf of their clients, that take months, cost as much as $15,000 per man hired.

Whatever their reasons for changing jobs, he continues, top-level people can expect the process to be a lonely, miserable experience and one that may easily take 6 months to a year.

Here's what the top-level job seeker should and shouldn't do.

• Don't resort to friends. They will only have a vague idea of your qualifications and accomplishments and chances are they won't do much active campaigning for you.

• Talk to management consultants

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Money Saving—Product Improving

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ISO-OCTYL **DECYL** **TRIDECYL**

(BRANCHED PRIMARY ALCOHOLS)
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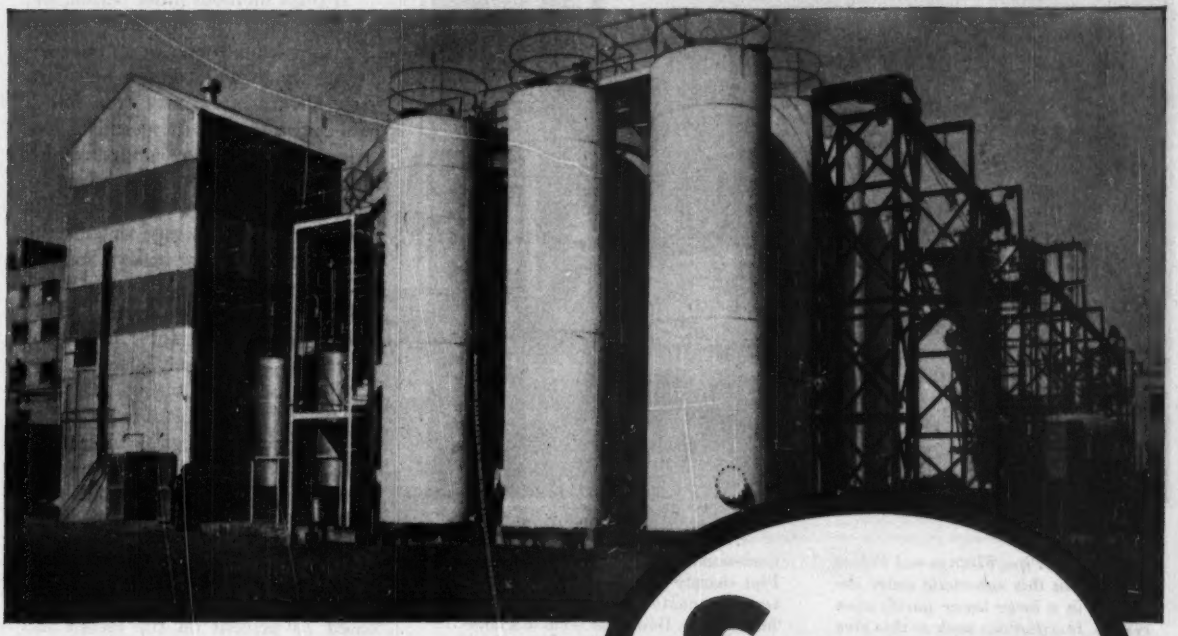

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A pioneer and leading marketer of Oxo Alcohols, the Enjay Company and its affiliates with greatly expanded plant facilities are producing a new line of branched primary alcohols. More and more manufacturers of esters, plasticizers, synthetic oils, detergents and other chemical derivatives are turning to Enjay for money-saving, product-improving Oxo Alcohols.

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PARATONE	PETROHOL 95	PETROHOL 95
PARAFLOW	PETROHOL 99	PETROHOL 99
PARAPOID	Secondary Butyl Alcohol	Iso-Octyl Alcohol
PARADYNE	Secondary Butyl Acetate	Decyl Alcohol
PARATAC	Isopropyl Acetate	Tridecyl Alcohol
PETROHOL	Acetone	Benzene
Methyl Ethyl Ketone	Methyl Ethyl Ketone	Dicyclopentadiene
Dewaxing Aid	Ethyl Ether	Isoprene
Ethyl Ether	Isopropyl Ether	Butadiene
Isopropyl Ether	Dicyclopentadiene	Ethyl Ether
Reference Fuels	Naphthenic Acids	Isopropyl Ether
	Iso-Octyl Alcohol	Tripropylene
	Decyl Alcohol	Tetrapropylene
		Aromatic Tars
		Acetone
		Methyl Ethyl Ketone

The Enjay Company has long been recognized as a leader in the development and marketing of high-quality products for the oil, surface coating and chemical industries. Backed by greatly expanded plant and distribution facilities, the Enjay Company is supplying a constantly growing list of chemical products to many different industries.

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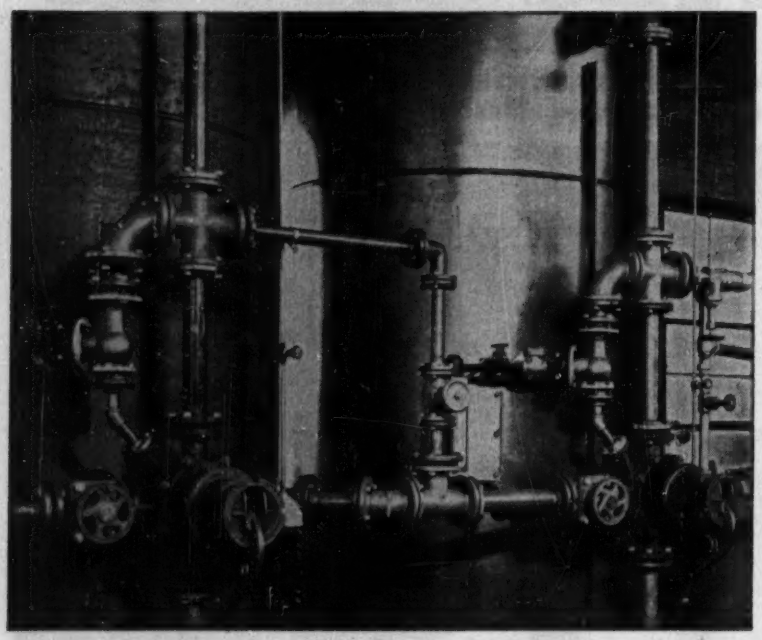
install corrosion-resistant

SARAN LINED STEEL PIPE

for long, trouble-free service



Saran Lined Pipe, Fittings and Valves are used in this automatic water deionizer in a large water purification system. Installations such as this give trouble-free service for many years.

Saran Lined Pipe Company
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Please send me a copy of your catalog on Saran Lined Pipe, Valves and Fittings.

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Corrosion-resistant Saran Lined Steel Pipe sharply reduces repair and maintenance costs in corrosive piping installations. Downtime is cut to a minimum because this rigid pipe has high pressure strength and durability—which mean dependable, long-term service. Easily installed Saran Lined Steel Pipe can be cut and threaded in the field—no need for special tools or handling. Wherever superior resistance to most chemicals and solvents is demanded, be sure to consider Saran Lined Pipe, Fittings and Valves. Write to the distributor: SARAN LINED PIPE COMPANY, 2415 Burdette Avenue, Ferndale, Michigan. Offices in: New York • Boston Pittsburgh • Tulsa • Philadelphia Chicago • Portland • Indianapolis San Francisco • Houston • Denver Los Angeles • Seattle • Cleveland Charleston, S. C. • Toronto • Montreal. Clip and send today!

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who specialize in the placement of executives.

"An eager executive on the prowl may register with a number of placement specialists, but if he's smart he will also try other methods. He may go to bank officers, talk over industrial situations, and obliquely indicate that he is considering a change. He may get himself invited to business luncheons and make a point of attending meetings of trade associations and similar bodies. He may invite a bunch of his business acquaintances for cocktails and discuss practically everything except his job status, trusting that those present will catch on.

"If these methods prove barren, the job-seeker may try something bolder. He may ask his lawyer or an advertising agency to write on his behalf to likely clients—or he may even hire a public-relations expert. Usually a job-seeking executive will undertake his own sales campaign, most likely by direct mail. He may try to do all the work himself, or engage one of the many small firms that make a business of it."

Once he succeeds in getting an interview, Stryker continues, he still has to sell himself. There is the risk of psychological tests. A good man may be rejected merely because an industrial psychologist has glibly interpreted his behavior. Then there is the test of the employer's prejudices and whims, one company going so far as to reject a candidate "because his teeth were too square." One placement man estimates that employers' judgments are based 20 percent on the record and 80 percent on personality.

OVERTIME PAY

. . . For Executives, Professional Employees

Popular opinion rather widely holds that executive, administrative, and professional employees should not be eligible for overtime payments. It is unusual for middle management or professional employees earning over $9,000 a year to be paid for overtime work. On the other hand, a considerable number of companies have broadened their policies on extra pay for extra hours to include employees in the pay brackets between $5,000 to $8,000 a year.

Overtime pay plans for executive and administrative staff were analyzed

AS HERCULES GROWS

Hercules Powder Company
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Its progress has been paced
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a program in which Bechtel
has served Hercules since 1939.

Over the years,
Bechtel engineering and construction
have been important factors in the growth
of the chemical industry.

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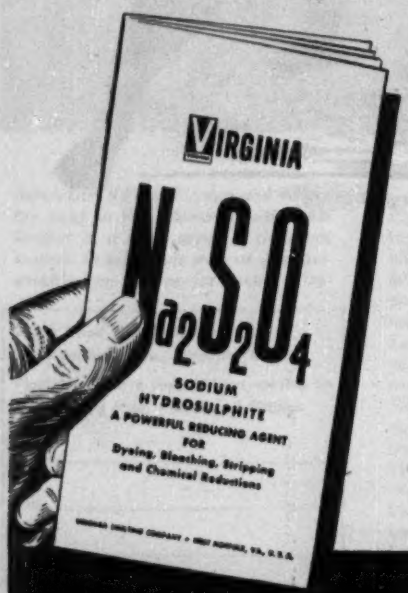
BUILDERS FOR INDUSTRY

Stronger Safeguards for Public Health

There is still considerable need for Salvarsan in treating certain serious diseases. This powerful, time-tried spirochete killer is invaluable in stubborn cases where the pathogenic organisms have built up an immunity against the new antibiotics. "Virginia" Sodium Hydrosulphite ($Na_2S_2O_4$) is one of the highly reactive chemicals used in the production of Salvarsan.

Here is another striking instance where a "Virginia" basic chemical steps outside its customary industrial role to perform an important pharmaceutical function. Our diligent research men have been tirelessly pioneering things like this for 30 years, in over 40 diverse fields of endeavor. Some of these applications have been sensational successes.



Concentrated "Virginia" Sodium Hydro is a uniform, free-flowing product with great reducing and bleaching power. It dissolves quickly, is stable in storage and in the bath. You may have a latent or clearly indicated need for this versatile chemical. Our engineers will cooperate with you in every possible way to develop efficient, profitable applications in your plant. Write us today on your business letterhead for a test sample of our $Na_2S_2O_4$ and for a folder outlining its properties and uses.

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Field Offices
NEW YORK
BOSTON
DETROIT
CHICAGO
ATLANTA

VIRGINIA Chemicals
SINCE 1898

in 72 relatively large companies.* These plans revealed the following:

1. Two-thirds of the companies paid overtime at the rate of time and one-half. The remaining companies paid overtime at the straight-time rate.

2. The 45 companies which authorized time and one-half imposed cut-off rates or taper points ranging up to $8,000 a year but concentrated at the $5,000 to $6,400 level. Only 20 percent of these plans did not fix a taper point.

3. A majority of the plans which paid overtime on a straight time basis did not place a ceiling on the rate. However, 10 plans did impose taper points, between $6,000 and $8,400.

4. The salary levels eligible for participation in the overtime plans ranged from $6,700 to $20,000. The majority of the plans provided a cut-off for eligibility within the range of $7,000 to $9,000.

The Bureau of Labor Statistics, in cooperation with the AEC, studied working conditions in electronic research laboratories of 25 large companies covering about 11,000 scientists. This represented almost one fifth of the total number of scientists employed in industrial laboratories as listed by the National Research Council. The data, collected in December, 1949, and published in the *Monthly Labor Review*, April, 1950, show:

1. Scientists observe regular work schedules. The usual schedule is eight hours a day and 40 hours a week.

2. Extra pay for overtime is provided by less than half of the companies included in the survey, employing about two-thirds of all the scientists studied.

3. The most common rate of overtime pay, in terms of the number of scientists affected, is straight time.

4. In most industrial laboratories, overtime is the exception rather than the rule. Overtime worked on an informal or incidental basis is usually not paid for even if there is a definite policy of overtime pay.

5. Only three companies, employing less than 6 percent of the scientists reported that overtime was frequent. —*Jerome M. Rosow, Creole Petroleum Corp.*, Personnel, Sept. '53, p. 105.

*Based on an analysis of 300 applications for overtime authorizations received by the Office of Salary Stabilization. Seventy-two of these applications defined plans covering groups of employees and not limited to one individual. —*End*

JENKINS PRACTICAL PIPING LAYOUTS 70

How to plan an INDUSTRIAL WASTE TREATMENT SYSTEM

In many areas, stringent codes have been drawn up to regulate the types and condition of waste which may be discharged into streams and rivers, in order to conserve existing water supply sources.

Industrial discharges usually require chemical treatment, and one of the most common problems encountered is the neutralization of acid waste. In the system shown here, lime is used as the neutralizing agent. The waste normally flows to a digester which allows for settlement of solids and serves as a storage center. Flow from the digester to the treatment tank is regulated by a liquid level controller.

The treatment tank is equipped with an agitator which mixes the waste with the lime slurry to provide a neutral solution. The proportion of lime to be added is determined by a recording pH regulator, which operates the control valve on the slurry line and admits the required amount of slurry for neutralization. The slurry is made by admitting quicklime and water to the lime slurry mixer, which is equipped with an agitator. Emergency lines for direct discharge bypassing the treatment system are indicated in the diagram.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

Diagram by Huxley Madeheim, Consulting Engineer

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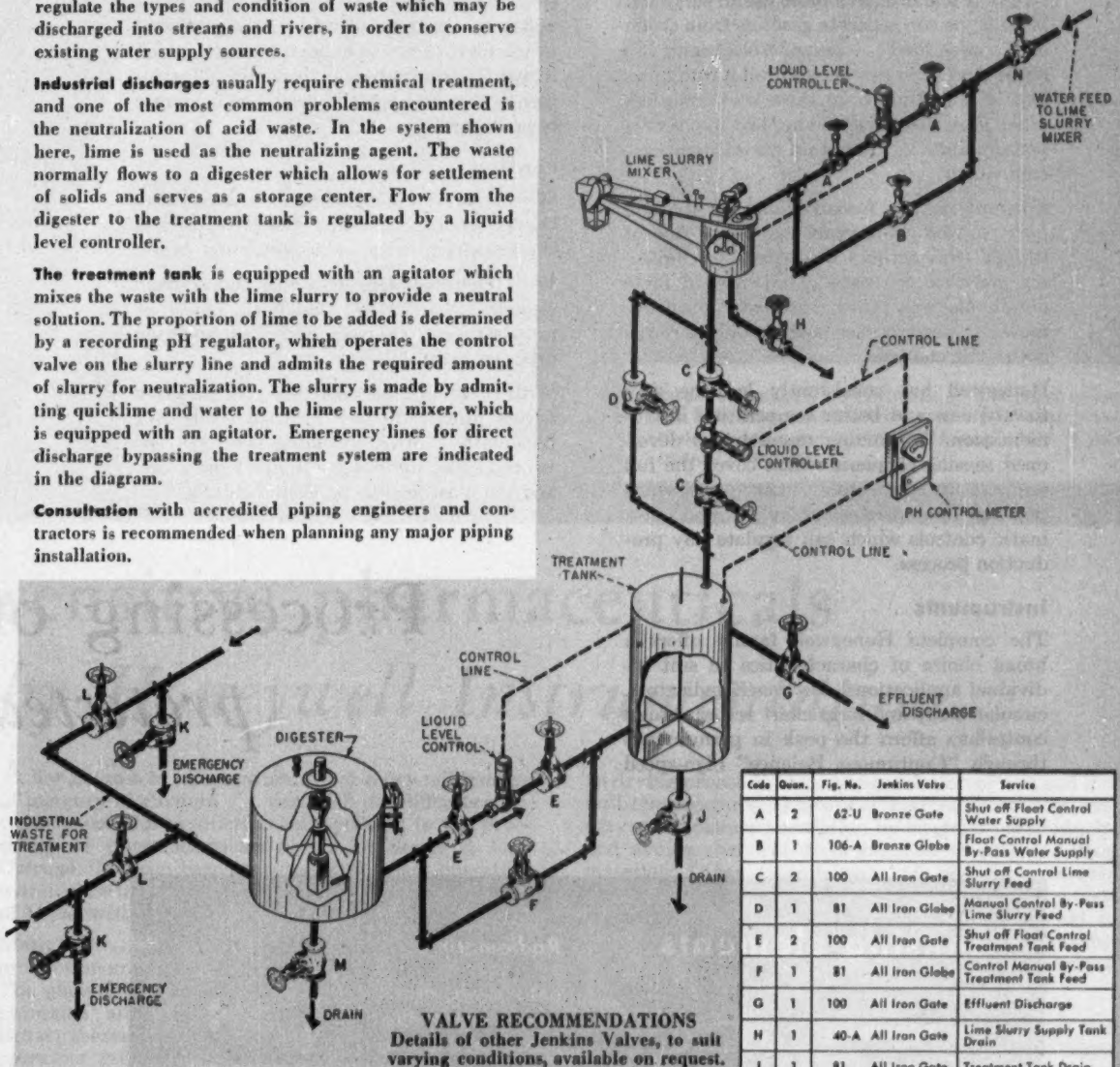

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Details of other Jenkins Valves, to suit varying conditions, available on request.

Code	Quan.	Fig. No.	Jenkins Valve	Service
A	2	62-U	Bronze Gate	Shut off Float Control Water Supply
B	1	106-A	Bronze Globe	Float Control Manual By-Pass Water Supply
C	2	100	All Iron Gate	Shut off Control Lime Slurry Feed
D	1	81	All Iron Globe	Manual Control By-Pass Lime Slurry Feed
E	2	100	All Iron Gate	Shut off Float Control Treatment Tank Feed
F	1	81	All Iron Globe	Control Manual By-Pass Treatment Tank Feed
G	1	100	All Iron Gate	Effluent Discharge
H	1	40-A	All Iron Gate	Lime Slurry Supply Tank Drain
J	1	81	All Iron Gate	Treatment Tank Drain
K	4	100	All Iron Gate	Emergency Waste Discharge
L	4	100	All Iron Gate	Shut off Waste Lines
M	1	81	All Iron Globe	Digester Drain

To simplify planning, to save time, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Simply ask for Piping Layout No. 70.

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Forward-looking research and production men realized some years ago that "rule of thumb" was entirely inadequate for replacing complex processes. They needed facts obtainable only from automatic measurement . . . performance possible only through automatic control.

Honeywell has consistently led the way toward new and better temperature instrumentation. Continuing research has developed sensing elements which cover the full temperature spectrum . . . instruments which provide the desired accuracy . . . and automatic controls which can regulate any production process.

instruments

The complete Honeywell family offers a broad choice of characteristics to suit individual applications. *ElectroniK* indicators, circular chart and strip chart recorders and controllers afford the peak in performance through "Continuous Balance" high-speed electronic measurement. *Pyr-O-Vane* millivoltmeter instruments fit many processes which need accurate indication and control. Brown Thermometers are economical instruments for recording and controlling moderate temperatures.

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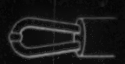
sensing elements

thermocouples



the most versatile of temperature elements, are supplied for ranges from −300 to +2800° F.

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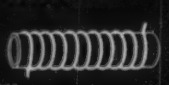
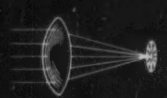


are recommended for highest accuracy from sub-zero to 300° F. and for narrow spans.

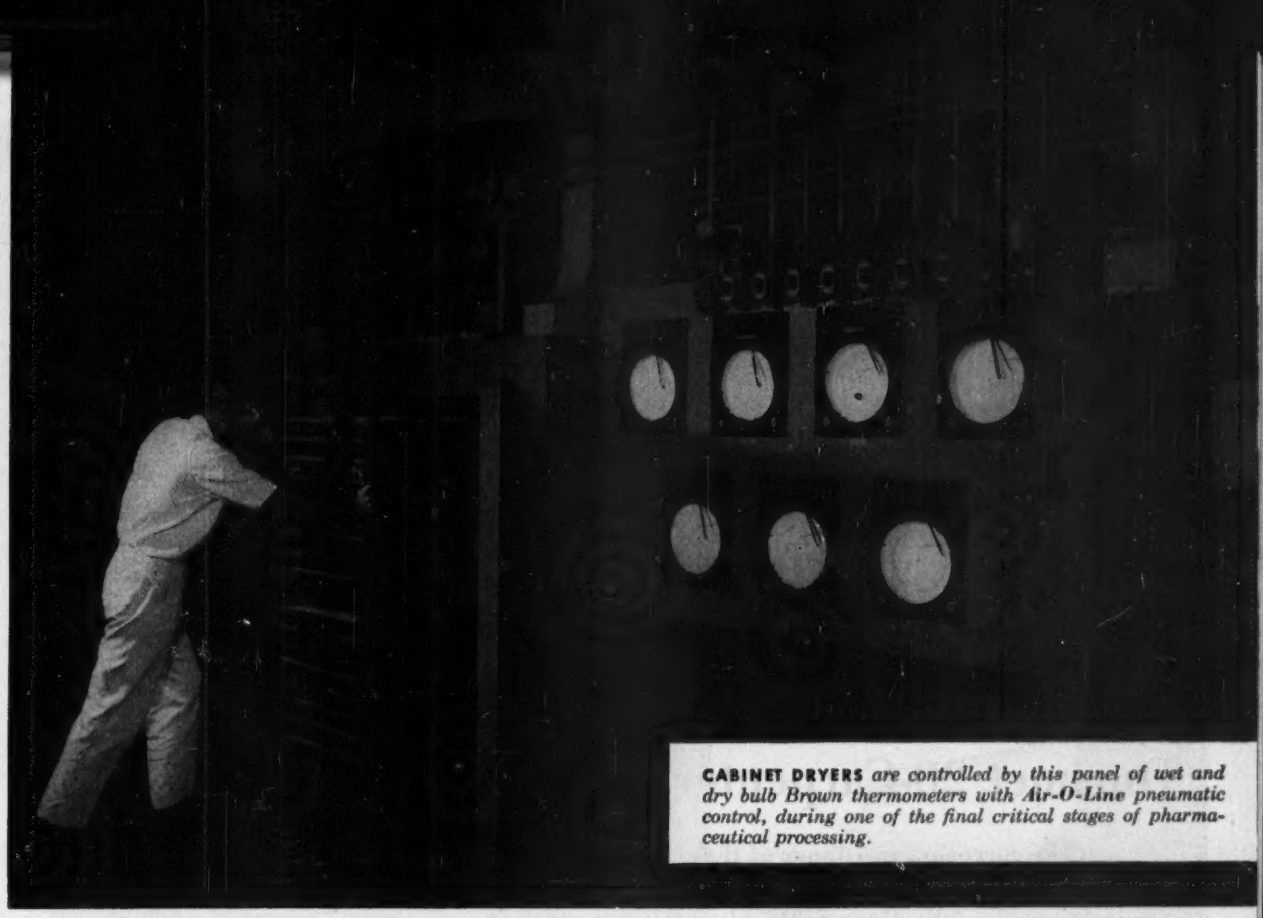
Radiamatic



(radiation-type) elements are applicable to direct measurement of work temperature . . . to moving objects . . . to extremely high ranges and other jobs impossible for any other element.

thermometer bulbs

rugged, sensitive elements for moderate temperatures.



CABINET DRYERS *are controlled by this panel of wet and dry bulb Brown thermometers with Air-O-Line pneumatic control, during one of the final critical stages of pharmaceutical processing.*

sensitive pharmaceuticals
by Honeywell Instrumentation

A few degrees in temperature . . . or a few millimeters of mercury of vacuum . . . can spell the difference between successful production and spoilage, in the processing of pharmaceuticals at G. D. Searle & Co., Chicago. To keep batch reactors and driers operating within close limits, this company utilizes a large number of Honeywell controls.

Many of the materials which go into pharmaceutical production are highly sensitive to temperature changes. The glass-lined reactors in which these materials are processed are thoroughly instrumented . . . with Brown thermometers to record vital temperatures for operators' guidance. Because pressure affects reactions too, many reactors are equipped with Brown absolute pressure indicators. These instruments, automatically compensating for atmospheric pressure changes, readily indicate vacuums within a few millimeters of mercury . . . and the operator does not have to correct readings for ambient conditions.

In drying processes, accurate regulation of wet and dry bulb temperatures, by means of thermometer controllers, prevents moisture absorption by hygroscopic products, and avoids chemical decomposition of sensitive drug materials. Other controls keep safe negative pressures in the drying cabinets, and protect steam heating coils from sudden overloads in cold weather. As an aid to cost accounting, evenly-graduated flow meters continuously check steam consumption of manufacturing departments.

Whether your own process is batch or continuous, you can help it reach highest efficiency with industry-proved Honeywell controls. Our local field engineer will be glad to discuss your requirements . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4478 Wayne Ave., Philadelphia 44, Pennsylvania.

● **REFERENCE DATA:** Write for Composite Catalog No. 5000, for a brief description of the complete Honeywell line.

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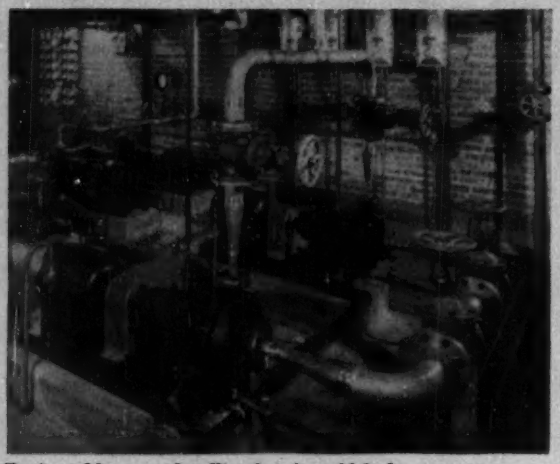
BROWN INSTRUMENTS
First in Controls



Durimet 20 pumps handling hot formaldehyde.

Durimet 20 plug valves handling 25 percent H_2SO_4 at 150 deg. F.

Durimet 20-Carpenter 20

The corrosion resistance of these important materials of construction to a number of corrosives, with physical properties and applications in the chemical industry.

WALTER A. LUCE
The Duriron Co., Inc., Dayton, Ohio

Durimet 20, Carpenter 20 and other trade name designations for this composition* constitute an important part of the corrosion resistant alloy field. This highly alloyed stainless composition augments the conventional 18 percent Cr-8 percent Ni stainless steels (Alloy Casting Institute grades CF-8 and CF-8M and AISI types 304 and 316) for the more severe services, especially sulfuric acid, and maintains at least equivalent resistance to those services for which the more conventional alloys are normally used. It essentially bridges the gap, cost-wise and corrosion-wise, between the 18-8-SMo alloy on one hand and the Chlorimet-Hastelloy alloys on the other. In many instances, the 20 alloy is being used in conjunction with 18-8 equipment for the less severe services because its superior erosion-corrosion resistance (pumps, valves and agitators) makes it the most economical composition. Use of Durimet 20 pumps in conjunction with 18-8-SMo pipelines and valves in formaldehyde service as shown in the above photograph illustrates this trend.

Nominal chemical composition of both the cast and wrought grades is given in Table I. This composition provides an austenitic structure which makes it similar in many important respects to the conventional austenitic stainless steels (18-8 varieties). Data on these other stainless steels were given in the May and June, 1953 Corrosion Forum for wrought types and in the October 1953 Corrosion Forum issue for cast grades. Reference to these will show this similarity in such important respects as mechanical and physical properties, machinability and welding characteristics. Table II provides data for some of the more important physical and mechanical properties of the 20 alloy for ready comparison. A more extensive discussion on other important characteristics of this alloy will be given in subsequent paragraphs.

Castings in this alloy can be obtained from many of the high alloy foundries in the United States and Canada. Although each foundry has its own designation for the 20 alloy, Alloy Casting Institute grade CN-7M pertains to this analysis. Such items as pickling hooks and racks, pickling rolls, cast pipe and fittings, tanks, towers and various other specialty castings are made for chemical handling. Castings are also supplied to equipment manufacturers who fabricate such items as pumps, valves, mixers, jets, filters, heat exchangers, fans, and centrifugals. Typical industries which are users of castings and cast equipment include chemical processing, food processing, metal cleaning and plating, mining, munitions manufacturing, oil refining, paint and pigment production, pharmaceuticals, plastics, pulp and paper making, soap and detergent manufacturing, steel mills, synthetic rubber production, textile and dyes.

The wrought material is available from the Carpenter Steel Co. in a variety of forms including bar, wire, strip, billets, tubing, pipe, sheet, and plate. Such specialty items as fasten-

Table I—Nominal Chemical Composition, Percent

	Cast (Durimet 20)	Wrought (Carpenter 20)
Nickel	29.00	29.00
Chromium	20.00	20.00
Molybdenum	2.00 min.	2.00 min.
Copper	3.00 min.	3.00 min.
Silicon	1.00	1.00
Carbon	0.07 max.	0.07 max.

* Durimet 20 is the trade name of the cast composition as produced by The Duriron Co., Inc. Numerous other suppliers of castings and cast equipment designate the alloy by such other trade names as Aloyco 20, Ecco 20, FA-20, Shawinigan 20, Utiloy 20 and others. Carpenter Stainless No. 20 denotes wrought products. All materials of this type are produced under patents of The Duriron Co., Inc.

Corrosion can be controlled

COOLING HOT CHLORIDES

Because of its unusual design, this heat exchanger has two to eight times the heat-transfer of plain bare pipe or tubing. HASTELLOY alloy B gives the assembly the necessary corrosion resistance. The exchanger, which was formed from alloy B strip, pipe, and elbows, handles hot chloride-bearing chemicals.

PREPARING PROTECTION

A HASTELLOY alloy C safety valve similar to the one being lapped here was inspected recently after handling 500 "pop" reliefs of scalding acid vapors. It was found that the alloy surface still had its original polished finish.

HASTELLOY *alloys can help solve your corrosion problems, too. For further information, contact the nearest Haynes Stellite Company office listed below.*

"Hastelloy" is a registered trade-mark of Union Carbide and Carbon Corporation.

HASTELLOY *alloys*
TRADE-MARK

Nickel-base, corrosion-resistant alloys available as sheet, plate, bar stock, welding rod, welded tubing and pipe; cast pipe and pipe fittings, sand and precision-investment castings.

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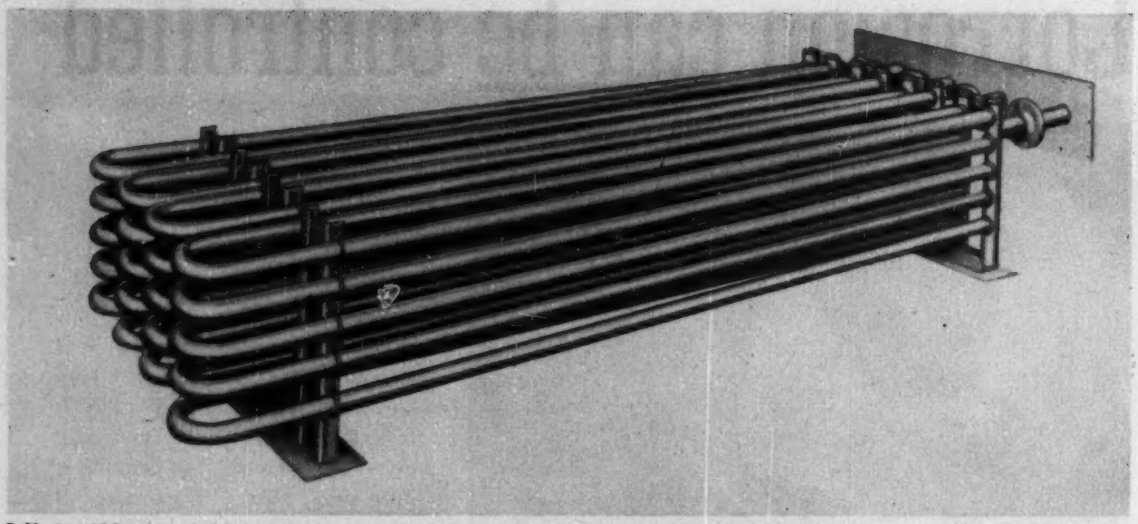


Sulfuric acid heater unit fabricated entirely from Carpenter 20. Note various wrought forms.

ings, wire screen and clad plate are made from these wrought products. Most manufacturers of stainless welding electrodes include this alloy in their regular stock. Industries utilizing these wrought forms are as equally diversified as mentioned in the previous paragraph for cast products. Typical items in Carpenter 20 include pump shafts and seals; valve stems; agitator shafts and fastenings; nozzles; heat exchanger tubes, brackets and supports; process piping and various fabricated tanks, kettles and towers. These are only a few of the many services for which it has proved successful. The sulfuric acid heater shown in the above photograph typifies the items which can be fabricated in Carpenter 20. It can be generally stated that any product which is fabricated in Types 304 and 316 can also be made in Carpenter 20.

The machining characteristics of the 20 alloy are much the same as for the 18-8 varieties. Experience gained with these other compositions can usually be applied for this alloy. Detailed information on specific machining operations can be obtained from The Duriron Co., Inc., The Carpenter Steel Co., or other producers of the 20 alloy but data on forging, hot working and cold working should be obtained only from the Carpenter Steel Co. Because of its austenitic structure, the alloy cannot be hardened by thermal treatment. Cold work is the only means for increasing the hardness above the nominal value of 150 Brinell.

The welding characteristics of the alloy are considered very good. In this respect it handles much the same as the cast and wrought 18-8 grades. Although it can be welded by the metal-arc, inert-gas arc and oxyacetylene gas methods, metal-arc welding is most frequently used. As stated previously, welding electrodes in this composition are readily available. The oxyacetylene method is not usually advisable because of possible impairment of corrosion resistance by carbon pick-up. For maximum corrosion resistance in the quench-annealed (water quenched from about 2,000 deg. F.) condition the carbon content is rigidly maintained at 0.07 percent maximum and any increase over this value could be detrimental. In this respect the Durimet 20-Carpenter 20 alloy is similar to the 18-8 analyses.

When welding castings, it is often recommended that the part be preheated to about 400 deg. F. and slowly cooled after the welding operation. Because the austenitic stainless alloys, including the 20 alloy, are subject to damaging carbide precipitation during the welding operation, all castings in this alloy should be quench annealed from 2,000 deg. F. after welding. This precaution precludes the possibility of intergranular corrosion in the weld zone when subsequently exposed to certain corrosive media.

Fabrication welding of Carpenter 20 is much the same as a comparable operation in Type 304 or Type 316. All wrought products are supplied from the mill in the quench-annealed condition and like castings, parts welded, forged or reheated in any manner during fabrication should be reannealed. The only exceptions to this are Carpenter 20 plate, sheet and tubing which are so processed as to allow fabrication by welding without further quench-annealing. It is important to emphasize that all cast and wrought products are given the necessary quench-annealing operation in the foundry or mill as part of the production cycle to assure maximum corrosion resistance and it is only those parts given subsequent thermal operations which require a reanneal.

Extensive experience has been gained on the corrosion resistance of the Durimet 20-Carpenter 20 alloy. Although resistance to sulfuric acid has been its main advantage, the 20 alloy shows superior resistance to the 18-8 alloys in many other services. Applications where this composition has proved vastly superior include hot acetic acid, brines, strong hot caustic

(*Continued on page 288*)

Table II—Mechanical and Physical Properties

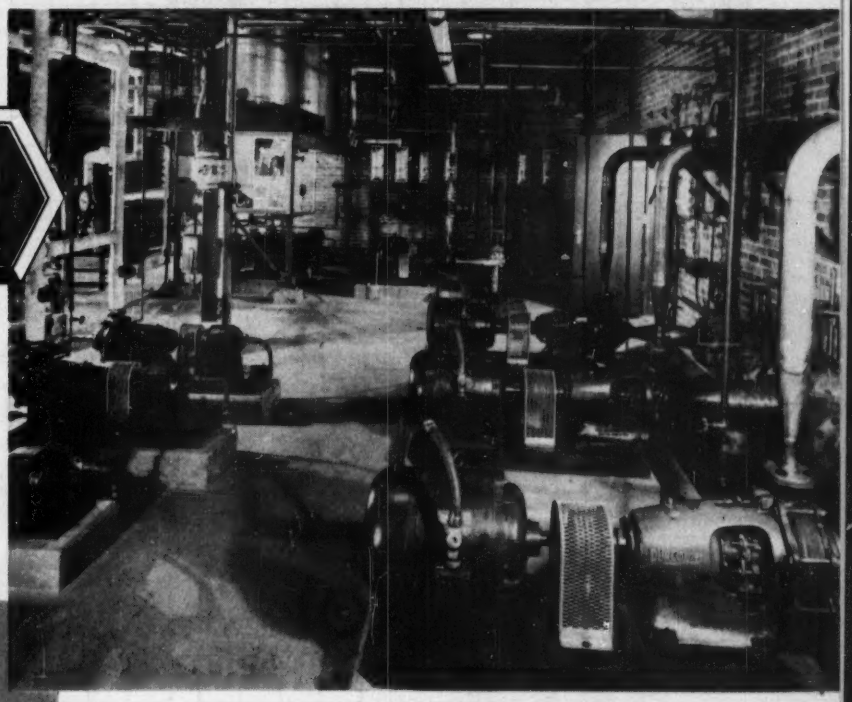
	Cast	Wrought
Tensile strength, psi	65,000 min.	85,000 min.
Yield strength, psi	30,000 min.	35,000 min.
Elongation, % in 2 in.	30–45	35–50
Hardness, Brinell	120–150	150–180
Specific gravity	8.02	8.02
Specific heat	0.12	0.12
Thermal conductivity, cgs	0.05	0.05
Coefficient of thermal expansion, mean 68° F. to 392° F.	8.6×10^{-6}	8.6×10^{-6}

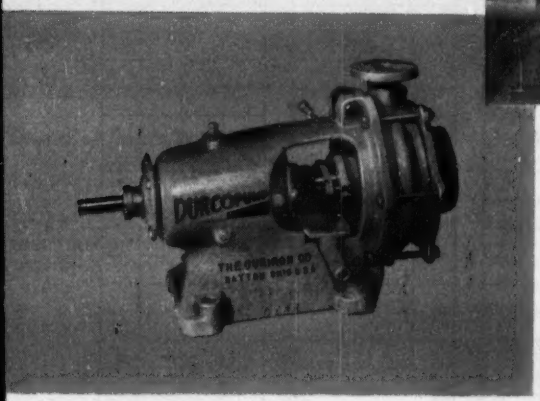
Another leading manufacturer who relies on corrosion resisting

DURCOPUMPS

SPENCER

These Series R Durcopumps have been in service at Spencer Chemical Company since 1948





These DURCOPUMPS have been in operation since 1948 serving Spencer Chemical Company at their Calumet City plant in the manufacture of formaldehyde.

Spencer Chemical Company is truly one of America's growing names in Chemistry, with plants in Pittsburg, Kansas; Henderson, Ky., Calumet City, Ill.; Charlestown, Ind., and Vicksburg, Miss. In addition to formaldehyde, which is widely used in the resin and plastics fields as well as in other familiar industrial applications, Spencer products include Methanol, 83% Ammonium Nitrate Solution, SPENSOL (Spencer Nitrogen Solutions) Ammonium Nitrate Fertilizer, FREZALL (Spencer Dry Ice), and Liquid Carbon Dioxide.

Series R DURCOPUMPS are designed and built for heavy-duty chemical service. From the rugged, reinforced frame, through-bored for best bearing alignment, to the heavy-vaned rotating element with micro adjustment, and oversized ball bearings, DURCOPUMPS are built for service. A renewable shaft sleeve is sealed to the impeller head by a super-finished joint. Bearing adapters are locked to the shaft without the use of setscrews. All parts in contact with corrosive solutions are of the right high silicon iron or stainless steel alloy to fit your corrosion problem.

THE DURIRON COMPANY

Dayton 1, Ohio

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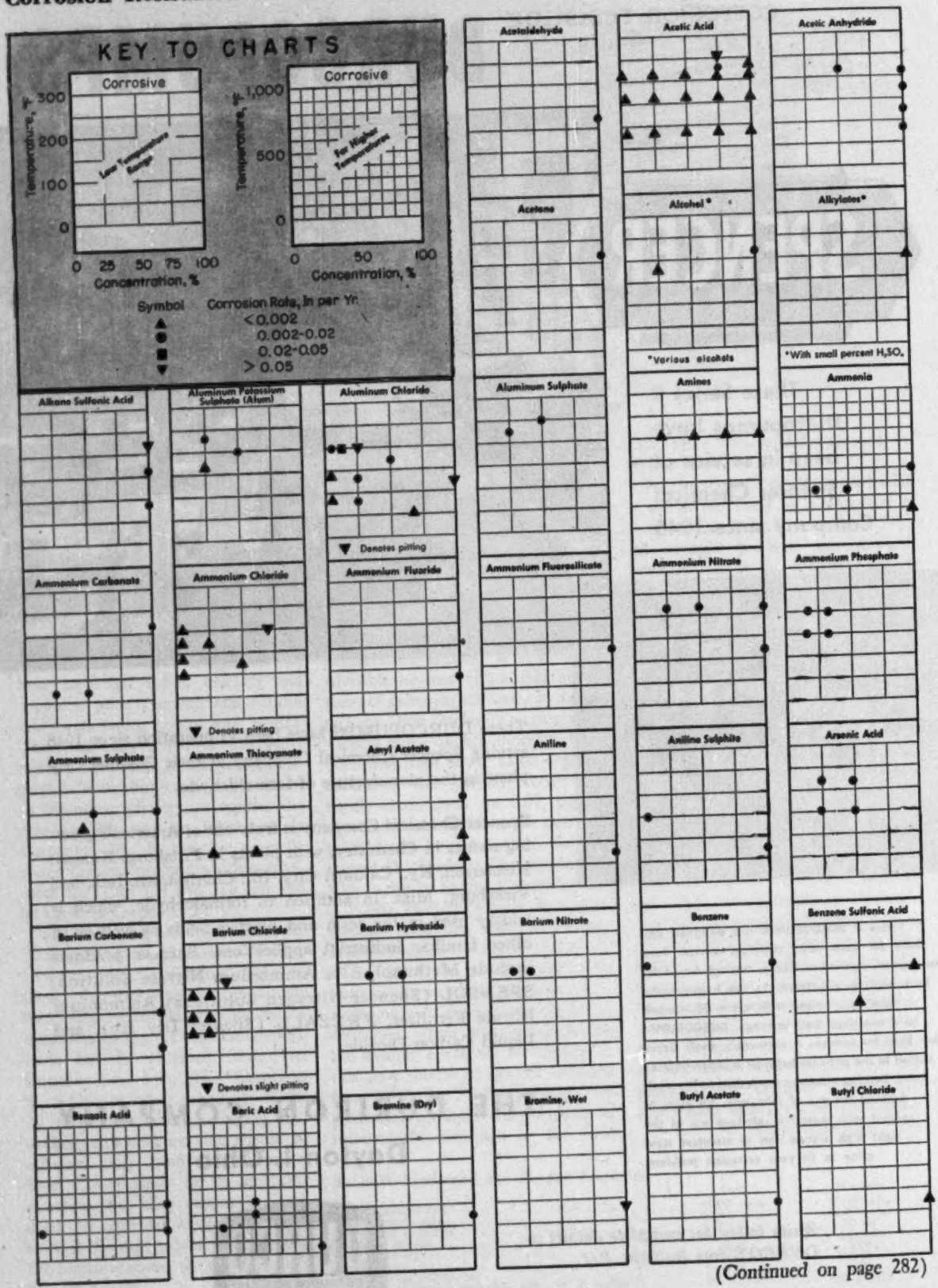
DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

Corrosion Resistance of Durimet 20-Carpenter 20, *cont.* . .



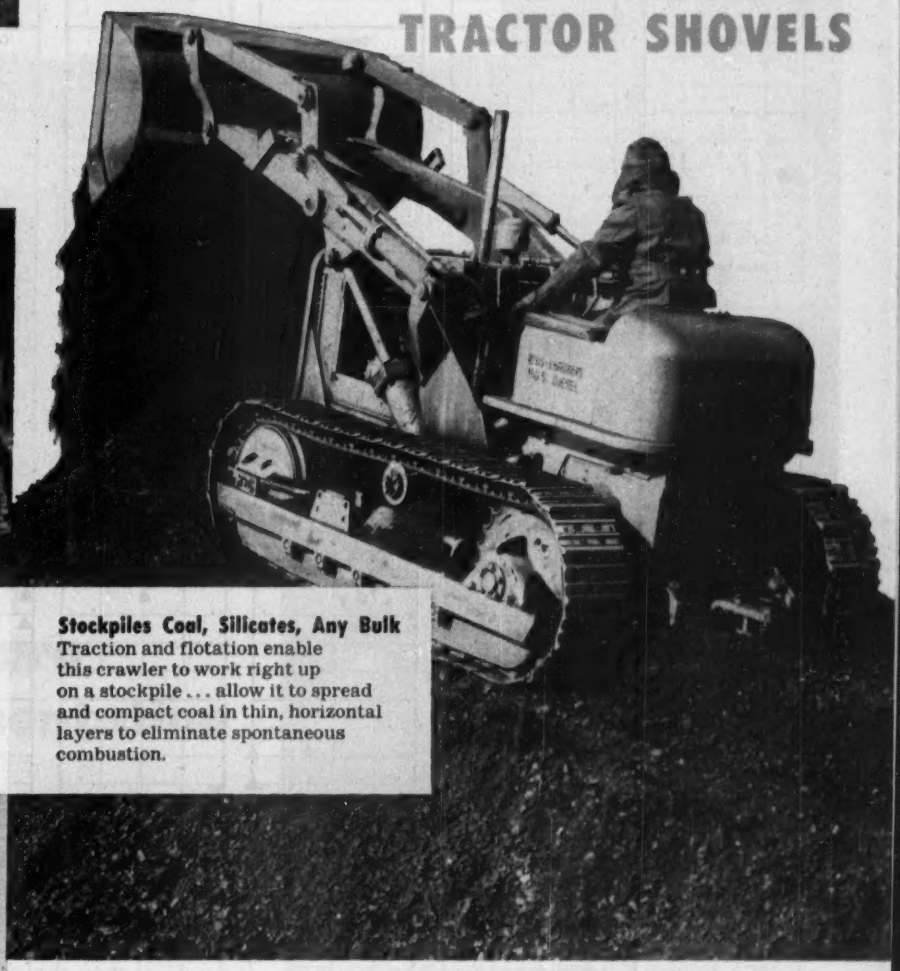
(Continued on page 282)

New Trends in Mechanized Materials Handling

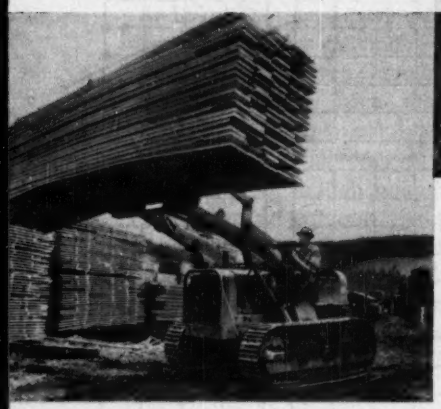
WITH ALLIS-CHALMERS TRACTOR SHOVELS

Feeds Hoppers, Conveyers
Special high-speed reverse increases output on short runs between stockpile and hopper. Steel tracks stand up in cullet and other sharp, abrasive material.

Excavates, Loads Trucks
This busy crawler-mounted shovel has the power to dig into hard-packed materials — and bring it out, a full cubic yard at a scoop. In handling light materials, an interchangeable two-yard bucket doubles its capacity.



Stockpiles Coal, Silicates, Any Bulk
Traction and flotation enable this crawler to work right up on a stockpile . . . allow it to spread and compact coal in thin, horizontal layers to eliminate spontaneous combustion.



Handles Packaged and Solid Materials
With Lift Fork in place of bucket, the HD-5G skids, carries and stacks palletized loads weighing up to 4,000 lb. Stacking height beneath forks is 106 inches.

Crawler tractors — basic machines on earth-moving and construction jobs — are now solving more and more bulk materials-handling problems in industry with hydraulic front-end shovels. And spear-heading this new trend is the Allis-Chalmers HD-5G — thousands of which are now in use in plants of all types. This multi-purpose crawler combines power, traction and maneuverability with a wide selection of hydraulically operated attachments for a variety of material handling jobs.

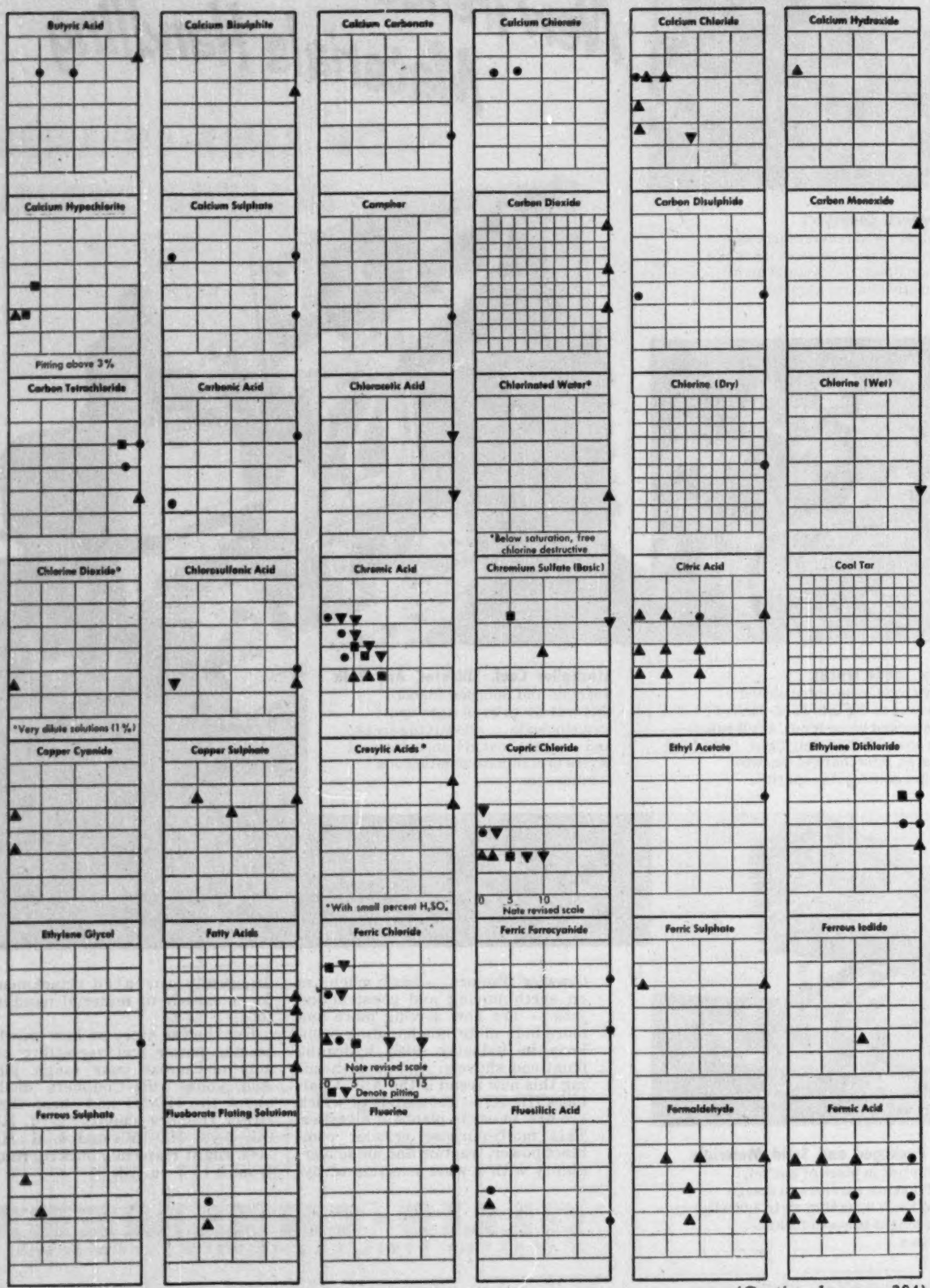
Get the full story on how crawler tractor power and versatility can help mechanize your tough jobs. Ask your Allis-Chalmers dealer about the HD-5G and these three larger tractors shovels: 2-yd. HD-9G, 3-yd. HD-15G and 4-yd. HD-20G. Light materials buckets range from 2 to 7 cu. yd.

ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

Here are a few of the other jobs the HD-5G and its attachments will handle:

Maintains yards and roads with bulldozer or shovel • Clears snow from parking areas • Moves machinery and other heavy materials with Crane Hook attachment • Spots railroad cars at loading docks • Digs trenches for pipe or foundation footings with Trench Hoe attachment

Corrosion Resistance of Durimet 20-Carpenter 20, *cont. . .*



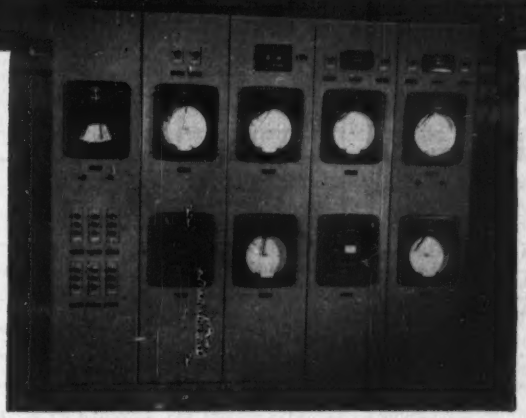
(Continued on page 284)

DAVISON *approaches automatic production in new catalyst plant*

...with Foxboro instrumentation

At Lake Charles, La., there's a new milepost on the road to fully automatic chemical processing. Here, at The Davison Chemical Corporation's new $7,000,000 plant, high quality silica alumina petroleum-cracking catalyst is being produced continuously, with only routine supervision, at the rate of 45 million pounds per year.

"Production catalyst" responsible for this successful operation is the effective use of advanced instrumentation. Specifically: Foxboro M/40 Stabilog Controllers virtually eliminate operating adjustments . . . hold process variables always within critical latitudes.



On this and four other instrument panels, Foxboro Instruments control temperatures and record flows and pressures at The Davison Chemical Corporation's petroleum-cracking catalyst plant, Lake Charles, La.

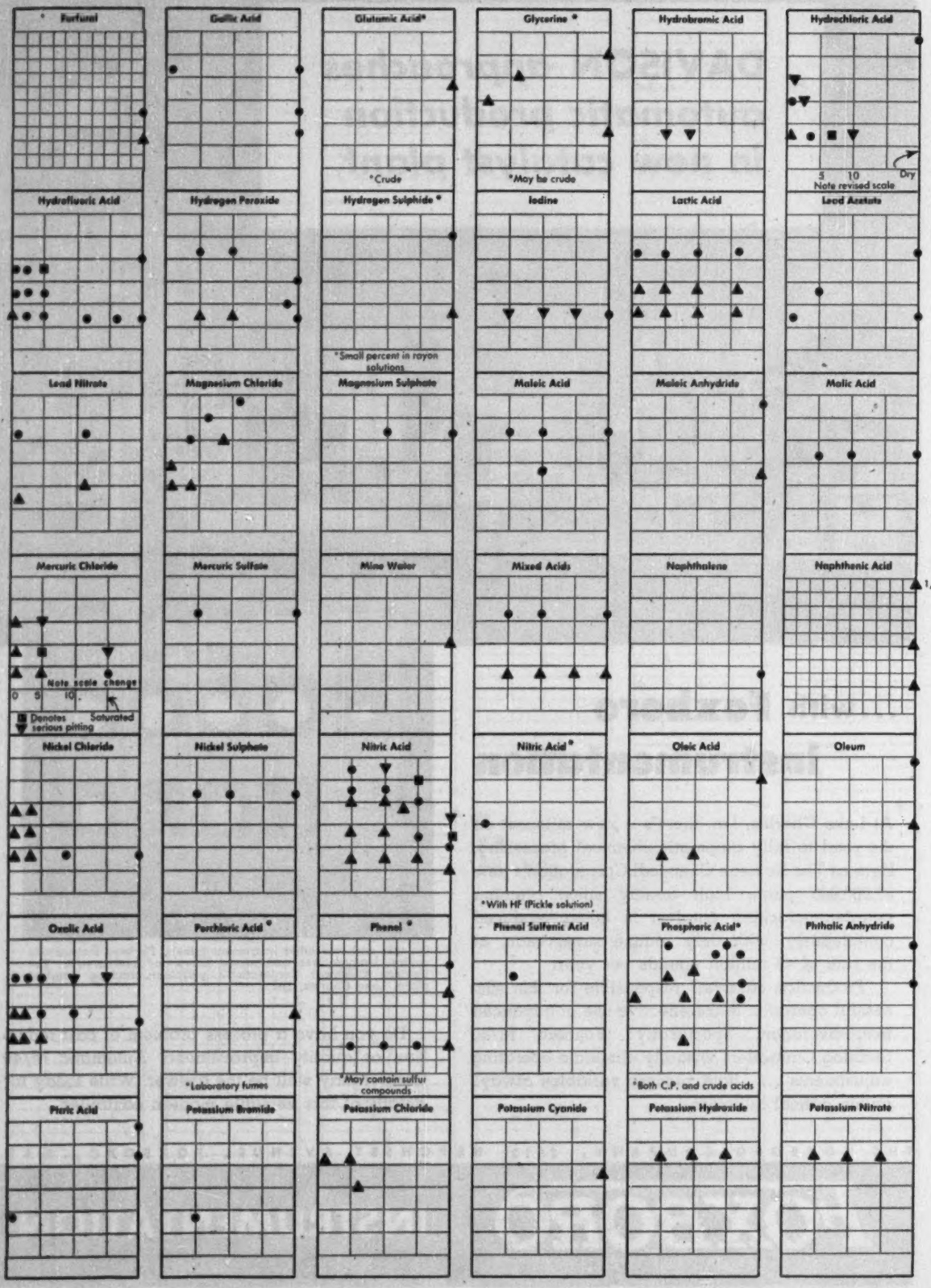
Do you have a process problem of cost reduction or quality improvement? Automatic M/40 Control may well be the answer. Write today for details of this versatile modern controller.

THE FOXBORO COMPANY, 3612 NEPONSET AVENUE, FOXBORO, MASS.

FOXBORO REG U S PAT OFF INSTRUMENTATION

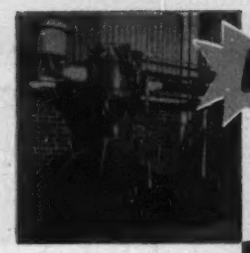
FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

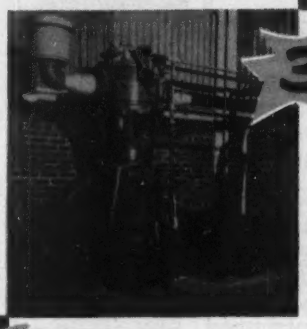
Corrosion Resistance of Durimet 20-Carpenter 20, *cont.* . .



(Continued on page 286)

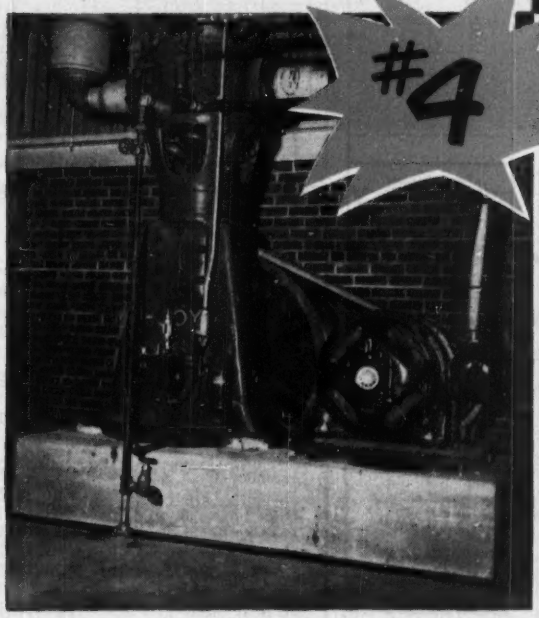
...They've added their FOURTH JOY WG-9 COMPRESSOR





Certain-teed's new Oklahoma paper mill uses compressed air in the manufacture of gypsum board papers. In addition, compressed air is used in general shop service, and it also furnishes the pressure for the ever-so-important automatic sprinkler system.

With such dependence upon air supply—24 hours a day—Certain-teed's engineers "bet on the Champ" and, for the fourth time in a row, specified a Joy WG-9 vertical compressor.



The WG-9 is a water-cooled, double-acting, single-stage compressor built to deliver medium amounts of air *constantly*. It, alone in its class, offers replaceable crosshead guides and cylinder liners, force-feed lubrication, and bearings that *never* need adjusting. As an extra bonus, "Dual-Cushion" valves are included to give higher valve capacity and better heat dissipation.

All-in-all, the WG-9 is a potent performer—able to take the measure of any compressor in its class. Get the specifications and check the record . . . you'll be convinced, too. Bulletin A-43 gives all data and will be sent upon request. ● ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

15 SIZES • 30 to 150 PSI • 172 to 881 CFM

FOR OIL-FREE OPERATIONS WE OFFER THE WGO-9 SERIES

Consult a Joy Engineer

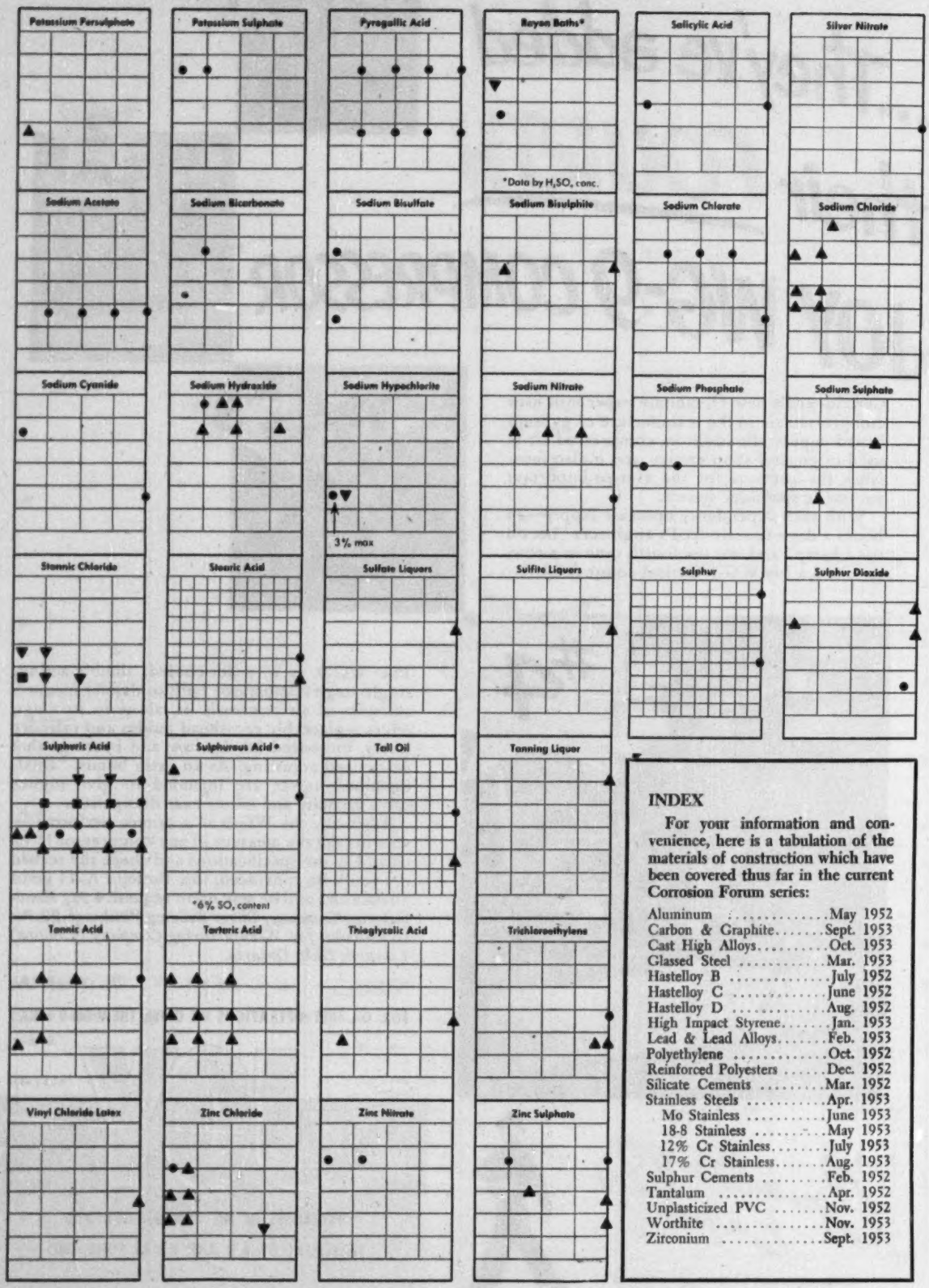
for Vaneaxial Fans . . . Compressors, Vacuum Pumps and Boosters . . . Oxygen Generators

JOY

WGD 1 4645

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

Corrosion Resistance of Durimet 20-Carpenter 20, *cont.* . .



INDEX

For your information and convenience, here is a tabulation of the materials of construction which have been covered thus far in the current Corrosion Forum series:

Aluminum	May 1952
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Worthite	Nov. 1953
Zirconium	Sept. 1953

DARCO Digest

DARCO DEPARTMENT • ATLAS POWDER COMPANY
Darco General Sales Offices—60 EAST 42nd STREET, NEW YORK 17, N. Y.
ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

The Darcograph quickly solves your carbon dosage problems

Adsorption of impurities by activated carbon follows a reliable logarithmic law. From this, it is possible to calculate the amount of carbon needed to accomplish a given reduction in color or other impurity, but the task becomes tedious and complicated.

Darco specialists have developed a graphical calculating device that will save you a great deal of time in determining minimum dosages. This device is called the Darcograph. It's mathematically correct . . . easy to understand . . . simple to use.

Furthermore, the Darcograph provides a ready means for setting up a minimum dosage chart for a given process where the nature of the impurities remains substantially constant. The process operator needs only to determine the color or impurity concentration of a batch of liquid . . . then reads from the chart the Darco dosage to purify to a predetermined minimum level. He can thus adjust the dosage from batch to batch to produce a constant purity in the finished product.

We'll be glad to send you, without charge, a Darcograph set.

2,000,000 gallons of solvent reclaimed by using DARCO

A chemical manufacturer recently was faced with the problem of what to do with two million gallons of expensive, high-quality solvent that had become slightly contaminated. To render it fit for sale, he could re-distill—at considerable cost.

A much more economical answer proved to be treatment with Darco activated carbon. Dosage of two pounds per 1000 gallons did the trick. And the total cost of purification amounted to only about one-tenth of a cent per gallon—a fraction of the estimated re-distillation cost.

Hydrodarco—for purifying water for process use

In the manufacture of fine chemicals, synthetic fibers, alcoholic beverages, soft drinks and numerous other products, a source of pure water is absolutely essential.

Especially developed for water-purification work, Granular Hydrodarco provides an economical means of removing foreign taste, odor and color. Because Granular Hydrodarco is used in specially designed units, it is not sold directly but through Infilco, Inc., specialists in water treatment. Their main office is located in Tucson, Arizona.

Hydrodarco lasts a long time. Under normal conditions, a charge gives a year's service before it needs replacement. Maintenance requirements are extremely low once the installation has been placed in service. Altogether, treatment costs with Hydrodarco amount to an exceptionally low figure per million gallons of water.

This LAMINEX Etching Trough
FIBERGLASS
saves wear and replacements!
LIGHTER, STRONGER, SMOOTHER, BETTER — yet costs less than stainless steel

"Make us an
ETCHING TROUGH
that won't break, crack, chip or leak!"

A leading mill asked Laminex for an etching trough to supplant ceramic troughs (very brittle, easily cracked, impossible to repair, often needing replacement within 1 to 3 months) and wooden troughs (leaky and therefore expensive, causing bad labor relations because acid drip is injurious). We produced the trough shown above — costing less, lasting longer, quickly repaired on the spot by unskilled labor. Another production problem solved by Laminex with —

★ Toughness ★ High flexural strength ★ Non-corrosiveness ★ Imperviousness to weather and humidity ★ Non-conductivity ★ Super-smooth interior ★ Light weight ★ Lower cost than stainless steel ★ All advantages of laminated fiberglass.

We regularly produce Laminex tanks, trucks, containers, hoods, vents, dustwork, buckets, sheets, etc. For you, as throughout industry, Laminex molded or fabricated fiberglass construction can solve countless problems. Let us show you — without obligation!

Write for Free Laminex Data Sheet or to have a Laminex Representative advise you. No obligation!

LAMINEX CORPORATION
994 Jefferson Street, Fall River, Mass.

solutions, hydrofluoric and hydrofluosilicic acids (dilute), strong nitric acid (fuming), nitric-hydrofluoric pickling acids, hot sulfates and sulfites, sulfuric acid (all concentrations to 150 deg. F., many to 176 deg. F. and higher), sulfurous acid, phosphoric acid and plating solutions. Sulfate solutions usually have sufficient free acidity to make them damaging to the 18-8 alloys and require the use of a superior composition. Its ability to exhibit superior resistance under erosion-corrosion conditions, or during the alternate handling of different corrosives, or where reducing contaminants exist has made it a valuable addition to the field.

Detailed corrosion data are given in the accompanying charts. These are actually a compilation of existing plant and laboratory data which have been accumulated over a number of years of close association with the chemical industry. Other articles in this series have warned that each service should be considered on its own merits and that it is often hazardous to use corrosion data of this type as more than a general guide to material selection. These same precautions obviously pertain to these data although they were mostly obtained from actual plant experience. Thus if additional comments or background information are desired for a given service it is suggested that one of the producers of this composition be consulted.

Comparison of the charted data with similar information on Type 316 stainless steel (June 1953 Corrosion Forum) illustrates the superiority of the 20 alloy for many corrosives. It shows that this alloy also closely approaches the resistance of the nickel base high alloys (Hastelloy C - Chlorimet 3 type) for most services.

In many instances where data were given at some elevated temperature no effort was made to repeat the rating at a lower temperature for the same concentration. It can be assumed that at least the same rating pertains to all lower temperatures for these same concentrations. In many instances it was necessary to depict plant service data in the 0.002-0.020 ipy. category although there was a good indication that it might actually be in the lower category (below 0.002 ipy.). Rather than make an exaggerated interpretation of plant data, good serviceability of many years duration was given a 0.002-0.020 ipy. rating.

Lubricated INSURANCE POLICY

Ever hear of a lubricated insurance policy?

That's really what you're buying when you install power operated Nordstrom valves. You're buying *Prevention* and *Control.*

Prevention, because in a Nordstrom protective lubricant seals tighter than any other method, yet makes a sliding contact surface for instant easy operation on a quarter turn.

Control, because Nordstrom valves can be equipped for electric, hydraulic or pneumatic operation, with automatic, manual or remote control.
Rockwell Manufacturing Company, Pittsburgh 8, Pa.

ROCKWELL Built Nordstrom Valves

Lubricant-Sealed for Positive Shut-Off

Another ROCKWELL Product

Lubricant makes a valve easier to operate, just as it will nearly any mechanical device. But that's far from its only function in a

NORDSTROM....

A system of internal grooves deposits a seal of lubricant, under pressure, around each port to prevent both internal and external leakage.

A NEW VALVE

properly maintained, stays new for many years—always tight, always ready to operate in an emergency, because the lubricant in a Nordstrom valve keeps erosion-producing seepage from starting in the first place, filling the smallest scratch on the seating area with a film of plastic sealer.

EVERY TIME IT'S LUBRICATED

a Nordstrom valve is renewed—a new self-sealing seat around the valve ports. So, because they stay tight so much longer, Nordstrom valves, with systematic maintenance, actually lower operating costs.

Rockwell Manufacturing Company,
Pittsburgh 8, Pa.

Nordstrom Valves Another Quality **ROCKWELL** Product

Names in the News

Men of the Month:

Felbeck . . . Curme . . . Davidson

J. G. Davidson
George O. Curme, Jr
George T. Felbeck

Carbide's top team behind coal hydrogenation, three men who think in terms of hundreds of millions of dollars.

"Let George do it," often means that a job may never get done. But that wasn't the case with Carbide where, not one, but "three Georges"*—Davidson, Curme and Felbeck put their combined savvy behind what *Fortune* has called "one of the great events in the technical history of our time," chemicals by coal hydrogenation.

*As Arthur W. Baum writing in the *Saturday Evening Post* has tagged them.

Dr. Joseph George Davidson, president of Carbide and Carbon Chemicals Corp. and Dr. George Oliver Curme, Jr., Union Carbide's vice president and director of research, both men brilliant chemists, are the ones who pioneered the research and convinced the company's directors that the millions they were allocating for coal hydrogenation would one day pay off. How well they called the shot is shown by the fact that now, 20 million dollars and eighteen years later, it's reported that the directors are thinking in terms of forty-five to several hundred millions for a commercial plant. That will put private enterprise in the same league with the enormous Atomic Energy Commission and will elevate Davidson, Curme and Felbeck to the rather select strata of men who can think and plan in terms of these staggering expenditures.

Dr. George T. Felbeck, vice president of Carbide and Carbon Chemicals Corp. is the engineering member of the triumvirate. With the help of Paul Alspaugh, project manager, he bossed the design of the Institute plant.

Besides being one of Carbide's most able administrators, Felbeck easily qualifies as one of the nation's top engineers and there isn't a chemical engineer in the country who wouldn't give his slide rule for a chance to work with him. One of Felbeck's contemporaries recently appraised him this way: "You can't scare George with any job, I don't care how big, complex or 'impossible' it is." Felbeck's record bears this out.

In 1948 he got the Hyatt award for engineering the large-scale manufacture of polyethylene, badly needed during the war for radar equipment. Felbeck's process pumped ethylene to 30,000 psi. and kept it there long enough for polymerization to take place. After that job he took on the design, construction and operation of the Oak Ridge gaseous diffusion plant. Then came the pilot plant at Institute where Felbeck's achievements need no further documentation.

Many superlatives have been written about these top men in Carbide's coal hydrogenation; many other words of praise will never be written because all three men are exceedingly modest. So too, will many more engineers, scientists and technologists at Carbide know only the reward of materially changing the world we live in—changing it for the better.

P. W. Blaylock. Vice president in charge of development, Shawinigan Chemicals. With company since 1934.

Carl S. Carlson. Director of research, Morton Salt Co. Formerly with Standard Oil Development.

Alden R. Loosli. Manager of newly formed market research and development dept., Calco Chemical Division of American Cyanamid. Continues as assistant to the general manager.

W. H. McConnell. Vice president, sales, Diamond Alkali. With company 25 years.

C. E. Lyon. Works manager of Diamond Alkali's electrochemical plant at Houston, Tex., elected a vice president.

J. C. Harris. From assistant research director of Monsanto's central research dept. to director of newly established application research dept.

A. L. Geisinger. Vice president appointed general manager of Diamond Alkali's new plastics and agricultural chemicals division. General manager of Diamond's new chromium chemicals division:

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- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

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THERMO ELECTRIC extension wires utilize the most advanced synthetic insulations — they maintain accuracy by protecting wires from moisture, petroleum products, and most other chemicals, even after extensive use at temperatures as high as 600°F. This means longer service for wires, less replacement cost for you.

Industry, whether it be aircraft, chemicals, petroleum, plastics, metals, or any other field that requires accurate temperature measurement, profits from our experience and complete wire-making facilities. Our plant handles all phases of wire-making and thus maintains uniformly high quality. Standard wires are shipped from stock, special orders are produced promptly.

GET DETAILED DATA; WRITE FOR BULLETIN 31-E TODAY.

Thermo Electric Co. Inc.
FAIR LAWN NEW JERSEY

NAMES IN THE NEWS, cont. . .

Frank W. Jarvis, formerly president of Diamond Magnesium Co., a subsidiary of Diamond Alkali.

Robert B. Norden. Assistant editor, *Chemical Engineering.* Formerly engaged in process development work at Picatinny Arsenal. A chemical engineering graduate of the University of Michigan.

R. B. Norden

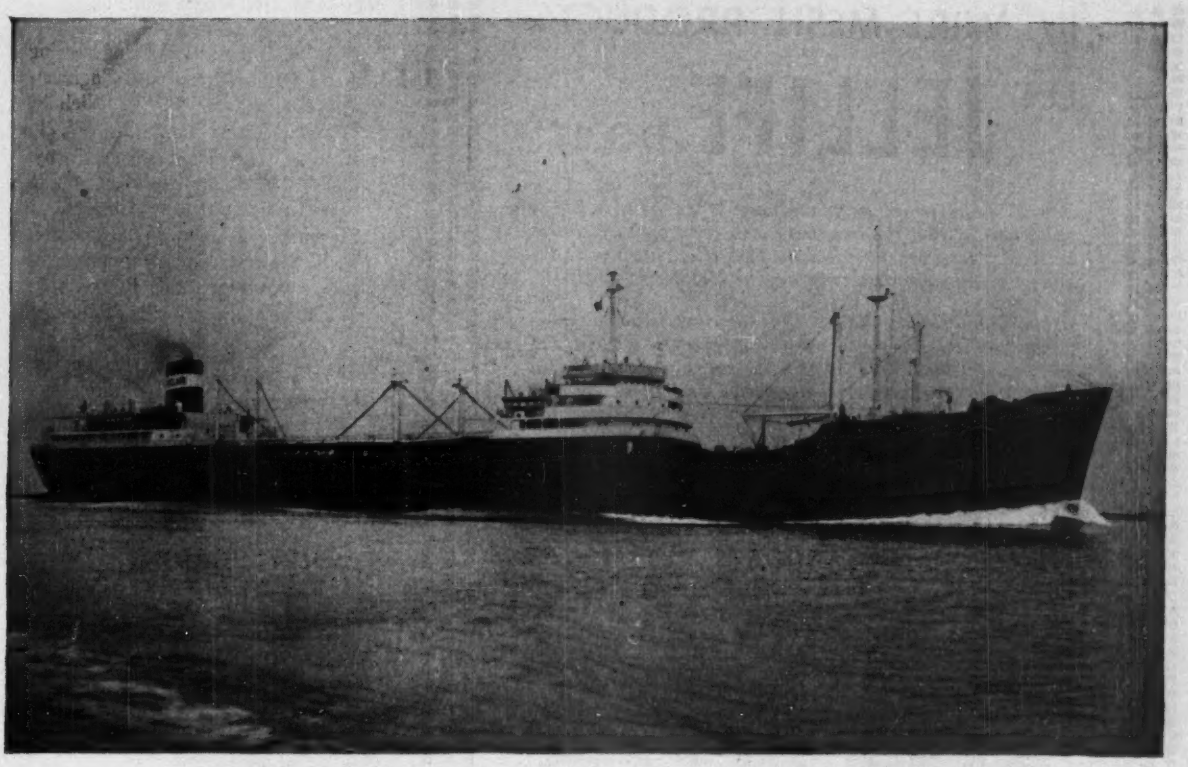
C. Victor Mars

C. Victor Mars. Vice president in charge of research and development, Ansul Chemical Co. With company for 22 years.

Charles F. Gerlach. General product manager, inorganic and agricultural chemicals, Michigan Alkali Division, Wyandotte Chemicals. New general product manager of organic chemicals: **Walter L. Rippeteau.**

George White, Jr. Executive vice president, Vitro Corp. of America. Continues as executive vice president, a director and member of executive committee of Vitro Manufacturing Co. and Vitro Chemical Co. Formerly with Shell Petroleum, M. W. Kellogg and Rubber Reserve Co.

E. R. Weidlein. President of Mellon Institute, named chairman of advisory committee of 24th Exposition of Chemical Industries. Members of the committee: **Roger Adams,** head of chemistry dept., U. of Illinois; **Raymond F. Bacon,** consulting chemist; **Hugh Craig,** editor of *Oil, Paint & Drug Reporter;* Farrington Daniels, president of ACS; **J. V. N. Dorr,** president of Dorr Co.; **W. F. George,** president of The Chemists' Club; **Sidney D. Kirkpatrick,** editorial director of *Chemical Engineering* and *Chemical Week;* **Robert J. McKay,** president of The Electrochemical Society; **R. J. Milano,** president of Salesmen's Association of America; **Walter J. Murphy,**



Sinclair Refining Company's P. C. SPENCER on her delivery trials out of Bethlehem's Sparrows Point Shipyard.

New Middleweight Champion

The "little supertanker" P. C. SPENCER, recently built for Sinclair Refining Company, is Bethlehem's answer to the quest for an "all-purpose" tanker—big enough and fast enough for transocean service, but small enough for most existing port facilities. The 25,000-ton P. C. SPENCER can go almost anywhere the 16,500-ton T-2 can . . . 10 to 20 per cent faster, with 50 per cent more cargo, with no additional cargo discharge time, with greater economy, with greater dependability.

Truly, she's a fitting addition to the long line of distinguished ships bearing the label, "Bethlehem-Built."

Main Particulars, P. C. SPENCER

Length overall	604′ 7½″
Length between perpendiculars	575′ 0″
Beam molded	78′ 0″
Depth molded	44′ 2¾″
Deadweight at assigned draft	25,200 tons
Draft to assigned water line (summer)	33′ 8″
Cargo tank capacity	212,425 bbls
Main cargo pumps capacity	15,000 bbls/hr
Shaft horsepower (maximum continuous)	13,750
Speed	17½ knots

SHIP REPAIR YARDS

Boston Harbor — New York Harbor
Baltimore Harbor — Beaumont, Texas
Los Angeles Harbor — San Francisco Harbor

SHIPBUILDING YARDS

Quincy, Mass. — Staten Island, N. Y.
Sparrows Point, Md. — Beaumont, Texas
Terminal Island, Calif. — San Francisco, Calif.

BETHLEHEM STEEL
Shipbuilding Division
GENERAL OFFICES: 25 BROADWAY, NEW YORK 4, N. Y.

On the Pacific Coast shipbuilding and ship repairing are performed by the Shipbuilding Division of Bethlehem Pacific Coast Steel Corporation

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For 73 years we've been weaving Wire Mesh. And a good part of that time we have also been making things of Wire Mesh for people who find it is cheaper, easier and generally more satisfactory to "let Jelliff do it."

From big Dipping Baskets to tiny precision filters—from fuel strainers to what-is-it *gadgets—JELLIFF'S Custom Production Department turns out fabricated Wire-Mesh products at speed, price and precision that means lower costs and a stronger competitive position for our many customers.*

If you buy or make wire-mesh assemblies as components of your own products and have not yet had an estimate from Jelliff, write today for details. No obligation, even if you enclose a blueprint for us to figure on. Address Department 15.

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LEKTROMESH
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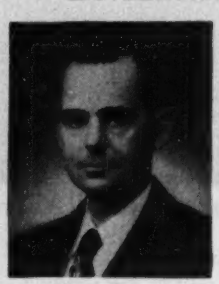
editor of *Chemical and Engineering News* and *Industrial and Engineering Chemistry*; **W. T. Nichols**, president of A. I. Ch. E.; **W. T. Read** of U. S. Dept. of the Army; **Charles F. Roth**, president of International Exposition Co.; **N. A. Shepard** of American Cyanamid; **E. K. Stevens**, associate manager of the exposition; and **R. Gordon Walker** of Oliver United Filters.

Robert W. Cairns. Deputy assistant secretary of defense (research and development). Formerly vice chairman of Research and Development Board, and previously with Hercules Powder Co.

——EAVESDROPPING——



". . . it is classified, and it usually stays that way forever."

F. K. McCune*

It really comes down to this: Most important work [on atomic energy] is being done not by the Government, not by laboratories, not by corporations, but by people. All the classified information starts in someone's head and becomes classified, if it does, when he puts it down on paper or tells it to someone.

Now, what is a scientist or engineer going to do when he talks to someone, writes up his experiment, issues his report, or writes a letter asking someone else to do something? If he were an expert in security matters, conversant with all the instructions and rulings, he might take a chance and write an unclassified document. But what does he really do? He probably says, "I don't know that this does not concern the manufacture or utilization of atomic weapons. I'm not entitled to know about weapons. Almost anything scientific may have a bearing on production of fissionable material or the use in production of power—and here, too, I'm not entitled to know much about the field, because of security, the need-to-know concept—but I'm responsible if I disclose it." So it is classified, and it usually stays that way forever.

*General Manager, Atomic Products Division, General Electric Co., in testifying at Hearings before the Joint Congressional Committee on Atomic Energy, July 9, 1953.

John W. Dunning. Vice president in charge of sales and research, V. D. Anderson Co. Formerly research director.

David B. Hertz. Director of engineering, plastics div., Celanese Corp. of America. With company since 1945.

William J. Haude. Vice president in charge of marketing, Grace Chemical Co. Formerly with Pittsburgh Agricultural Chemical Co. and John Powell & Co. of New York.

John P. Howe. Chief of atomic energy research dept.'s reactor materials section, North American Aviation. Formerly with General Electric's Knolls Atomic Power Laboratory. New group leader of chemical development: **Robert L. Loftness.**

Frank Lerman. Assistant research advisor at Illinois Institute of Technology's Armour Research Foundation. Formerly with VioBin, Vulcan Copper and Supply and Blaw-Knox.

William G. Hamlin. New member of Ohio River Valley Water Sanitation Commission. Formerly with Proctor and Gamble.

Louie E. Doxsie. Materials and methods superintendent, manufacturing dept., A. E. Staley Manufacturing Co. His successor as production superintendent: **James G. Dustin.**

J. Lawrence Amos. Director, new plastics production laboratory of Dow's Midland Division. Assistant director: **A. F. Roche.** Both formerly with the physical research laboratory.

Elmer H. Wegner. General manager of manufacturing, Cleaver-Brooks Co. Formerly with Ladish Co. His successor as works manager: **Glenn W. Leupold.**

E. R. Rowley. President, a director and member of executive committee of Titanium Metals Corp. of America. With National Lead since 1933.

Roger Adams. Recipient of 1953 Midwest Award of ACS's St. Louis Section. The prize is conferred annually upon a scientist of the

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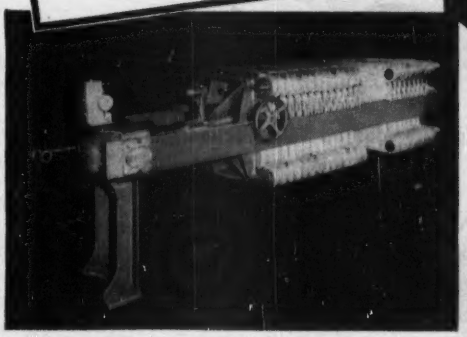
4 WAYS TO USE A FILTER



1—Filter to Recover Solids reasonably dry, firm, easy to handle.
2—Filter to Clarify, Purify, Decolorize, Deodorize, etc.
3—Wash or Extract to recover or remove soluble contents in filter cake.
4—Steam, Melt or Redissolve the cake.

In a Shriver Filter Press you'll find the one processing equipment that can do any or all of these operations—at any pressure—any temperature—under practically any conditions. That's a big claim, but as hundreds of plants have already discovered—we can prove its performance. Our laboratory is always ready. Our Catalog has the evidence.

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AUGER-MATIC Packing reduces dirt and waste . . . a time and labor saver. Packer can easily be moved from one filling point to another.

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NAMES IN THE NEWS, *cont. . .*

Middle West in recognition of "meritorious contributions to the advancement of pure or applied chemistry or chemical research." Dr. Adams is head of the dept. of chemistry at Illinois and one of the world's foremost organic chemists.

H. Clifford Bailey. Manager of Du Pont's plant at Beaumont, Tex., now under construction. With company since 1924, most recently as superintendent at company's Chambers plant at Deep Water Point, N. J.

Fred W. Stakelbeck. Executive vice president, Sharples Corp. With company since 1934. Continuing as vice president in charge of production.

F. W. Stakelbeck **C. R. Dolmetsch**

Carl R. Dolmetsch. Joined Mathieson Chemical Corp. in executive capacity. Formerly with Celanese.

Herbert C. Koehler. Manager of Monsanto's newly formed agricultural chemicals dept.

Morton M. David. Assistant professor of chemical engineering, U. of Washington. Formerly on faculty of U. of Utah. Most recently a visiting Fulbright lecturer at Indian Institute of Science in Bagalore, India.

James F. Eversole. Vice president in charge of research, Bakelite Co. With Union Carbide since 1929.

Blair Burwell. President of Salt Lake Tungsten Co., newly organized affiliate of Minerals Engineering and Sylvania Electric Products Co. Other officers: **E. C. Larsen,** Sylvania's chief engineer in the tungsten and chemical division, vice president; an **R. G. Sullivan,** vice president of Minerals Engineering, **J. B. Merrill,** Sylvania vice presi-

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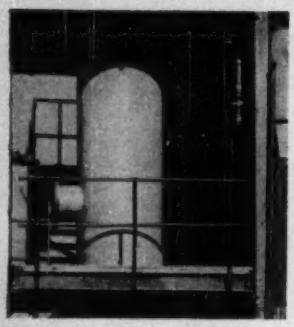

Scrubbing tower handling hydrofluoric acids and solvents at 250° F., 40 p.s.i. steel shell. Duro-Line membrane. Lecite joined brick lining.

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DURO-SAN — *Saran rubber lining.* Applied in sheet form. Resists acids, solvents and oxidizing acids.

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dent, **Leon J. Caine**, president of Caine Steel Co., Chicago, and mining consultant **Howland Bancroft** as directors. **M. N. Shaw** will supervise plant operations.

W. E. Hanford. Vice president in charge of research and development, M. W. Kellogg Co., elected a director of Pullman.

W. E. Hanford

T. B. Kimball

Thomas B. Kimball. General manager of refineries, Sinclair Refining. With company since 1930.

Thomas M. Ware. Vice president in charge of engineering devision, International Minerals & Chemical Corp., elected a director of Dunlap and Associates.

Norman Lieblich. General sales manager, Kieley & Mueller.

John R. Stoddard. Vice president in charge of sales, Prentiss Drug & Chemical Co. Formerly with John Powell & Co.

Mark E. Putnam. Executive vice president of Dow Chemical, elected a director of Campbell, Wyant & Cannon Foundry Co.

John F. Gorham. Instructor in chemical engineering, University of Maine. Formerly with American Cyanamid.

William Rodgers. Vice president and general sales manager, Blaw-Knox Co.

James A. Luker. Associate professor of chemical engineering at Syracuse. Formerly with U. of Mississippi.

J. H. Cole. Superintendent of chemical division, Standard Oil Co. of California's refinery at Richmond. Formerly assistant superintendent of light oil division.

Thomas K. Wells. General sales manager, Flexonics Corp. With company 12 years.

Murray E. Othmer. Executive assistant to vice president in charge of production, Sydney Ross-Winthrop Stearns International, Rio de Janeiro. Former head of chemical engineering, Tufts College.

Raphael Katzen. Chemical engineering consultant with offices in Cincinnati, Ohio. Formerly process design engineer with Vulcan Copper Supply Co.

W. P. ter Horst. Formerly associate director of research with Mathieson Chemical has established himself as an independent consultant with an office in McDonogh, Md.

A. J. Whitford. Chairman of the board of Ansul Chemical Co., succeeding **Harvey V. Higley** who has been appointed director of the Veterans Administration.

James A. Wilson. Production manager, International Minerals & Chemical Corp.'s chemical phosphates dept. in Florida. Previously with Monsanto.

J. C. Crowder. General superintendent, southern division, Consolidated Chemical Industries with offices in Houston. Formerly plant manager of company's Fort Worth hydrochloric and sulfuric acid plant.

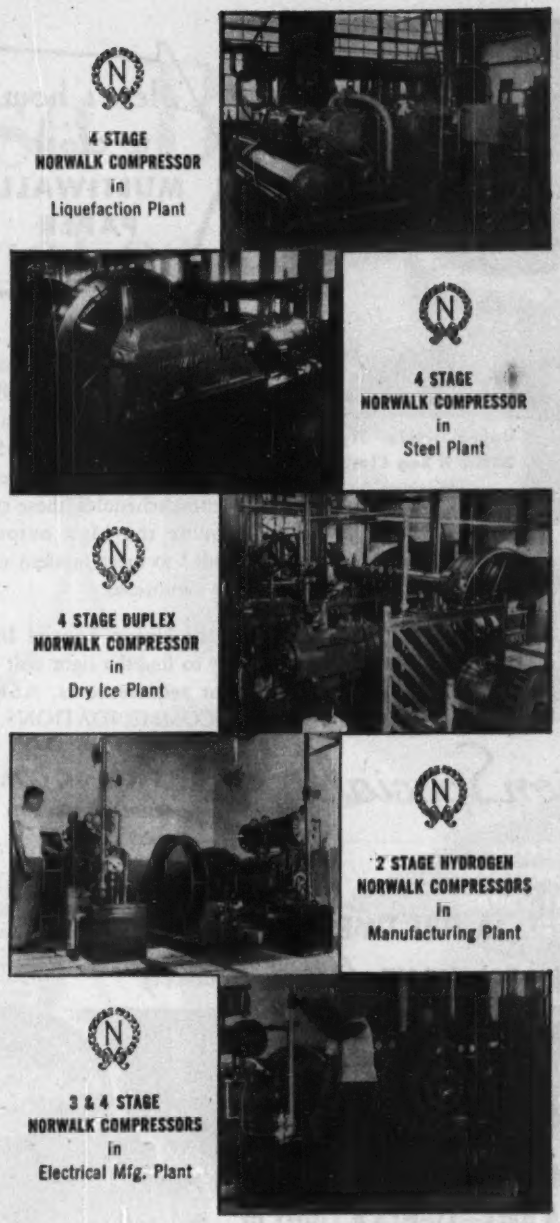
R. S. Dicks. Manager of chemical process engineering section of Celanese's textile division. Formerly with Shell Oil and University of Pennsylvania.

Roger G. Bossen. Manager of B. F. Goodrich Co.'s general chemical laboratories. With company since 1934.

G. E. Burks. Director of engineering, Caterpillar Tractor Co. His successor as chief engineer at the company's Peoria plant: **John E. Jass.**

G. J. Russ. General sales manager of U. S. Rubber's international division.

Loren C. Skinner. Chief engineer of Grace Chemical Co.'s nitrogen plant now under construction near



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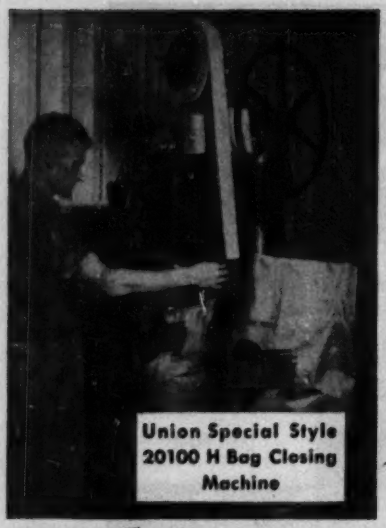

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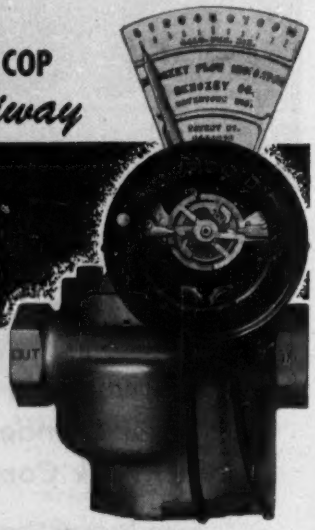

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There are only three moving parts in the HENSZEY FLOW METER — no breakdown due to complicated gears and mechanism. Goes right in the line — no additional supports. Indicates flow within 3% absolute accuracy, even with pulsating flow. Send for bulletin.

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Memphis. Formerly with U. S. Bureau of Mines synthetic fuels demonstration plant at Louisiana, Mo.

Kenneth Irey. Chemical production manager, Heyden Chemical. Formerly assistant manager of company's Garfield, N. J., plant. Previously with Monsanto, Resinox Corp., and Commercial Solvents.

Kenneth Irey

K. D. Nichols

Kenneth D. Nichols. General manager, Atomic Energy Commission, succeeding **Marion W. Boyer.** Major General Nichols was chief of the Army's Research and Development Program and was associated with the start of the atomic energy program.

Roy C. Williams. Manager of American Cyanamid's industrial chemicals plant in Joliet, Ill. With company since 1936.

Carlton M. Dean. Manager, engineering sales dept. of Monsanto's organic chemical division, succeeding **Thomas R. Harney** who has retired. Mr. Dean has been with Monsanto since 1917.

R. W. Van Tuyle. Vice president in charge of manufacturing and a director of Emery Industries. With company for 19 years.

J. S. Fawcett. Director of Fisher Scientific Co.'s development laboratories. Previously with Gulf Research & Development Laboratories.

John H. Thacher. Vice president of California Research Corp., subsidiary of Standard Oil Co. of California. With Standard since 1930.

Marshall T. Ramstad. Returning to position as manager of industrial dept., Tacoma, Wash., Chamber of Commerce after two years active

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MULTIWALL BAGS

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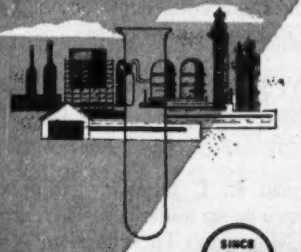

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over 100 years experience
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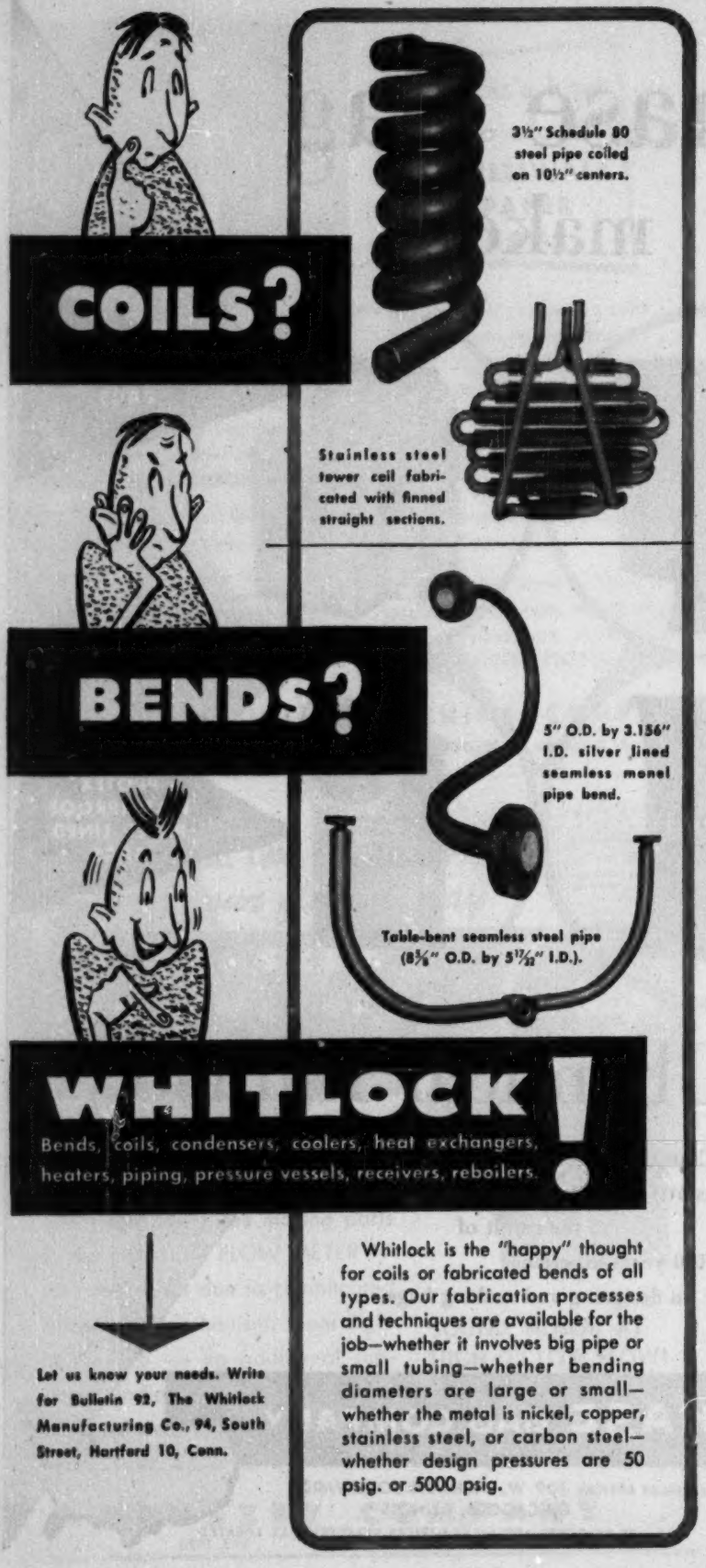
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3½" Schedule 80 steel pipe coiled on 10½" centers.
Stainless steel tower coil fabricated with finned straight sections.
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Table-bent seamless steel pipe (8⅝" O.D. by 5 17/32" I.D.).
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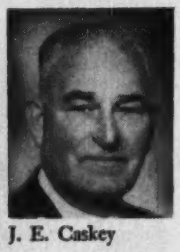
NAMES IN THE NEWS, cont. .

duty with the U. S. Navy at which time he headed up the Navy ammunition engineering and procurement section in Material Division, Bureau of Ordnance.

John P. Coe



J. E. Caskey

John P. Coe. To handle U. S. Rubber Co.'s interests in transfer of synthetic rubber plants from the government. Other changes: **John E. Caskey**, elected vice president and general manager of company's Naugatuck Chemical division, and **George R. Vila**, from general sales manager to assistant general manager of the division.

Fred W. Meyer. From chief engineer of refinery division to vice president, Bechtel Corp. With company 11 years.

A. R. Abelt. Vice president, sales, Chain Belt. With company since 1906.

Homer Lanier. Plant superintendent of Allied Chemical & Dye Corp.'s nitrogen division at Orange, Tex. Formerly assistant superintendent of the ammonia plant at the division's South Point, Ohio, installation.

D. C. Sanford. Manager of application engineering dept. Bristol Co. With company since 1937.

F. W. Borchers. General sales manager, Bristol Co. With company since 1922.

Sherman E. J. Johnsen. Senior research group leader in research dept. of Monsanto's Texas division. With company since 1942.

Charles Beckett. Chief of thermodynamics section, National Bureau of Standards. With bureau since 1950. Previously with American Petroleum Institute and Ohio State University.

Russell J. Dickson. General sales manager, Leschen wire rope division of H. K. Porter Co. Formerly company's Chicago district manager.

Robert O. Baughman. In charge of Automotive Rubber Co.'s newly enlarged rubber product development dept. Continues his functions as chemical laboratory head. Formerly with Goodyear.

OBITUARIES

J. E. Paul, 63, Philadelphia district manager of Sharples Corp., died September 1. With company 29 years.

Irving H. Morse, 85, chemist, inventor and author, and formerly with Louisiana Sugar, Cuban-American Sugar Cane and Mercidita Sugar, died on September 9 in New Orleans, La.

Samuel Arthur Mahood, 69, retired from Inter-Mountain Consumers Service in Denver, Colo., which he organized, former professor at Tulane, and earlier associated with Forest Products Laboratory in Madison, Wisc., died in Columbus, Neb., on September 11.

Edmund Everett Flood, 72, president of Pacific Paperboard Co. of Longview, Wash., died September 12.

George Martin Shepherd, 58, with the National Bureau of Standards for 32 years, died September 17.

Howard E. Stansburg, Sr., 73, pharmaceutical manufacturer of Seattle, Wash., died there September 21.

Clark T. Morse, 64, president of American Blower Corp. and Canadian Sirocco Co. and a director and member of the executive committee of American Radiator and Standard Sanitary Corp., died September 18 in London, Ontario.

Jasper P. Scott, 55, executive director of operations planning for Eli Lilly and Co., died September 8 in Indianapolis, Ind.

Charles Waggaman Berl, 57, market survey manager of sales research div. of Hercules Powder Co., died October 7 in Lewes, Delaware.

Why the
Weston
sensing element
is a
MULTIPLE HELIX!
Exclusively on
WESTON
all-metal THERMOMETERS
Although WESTON provides sensing elements of various forms for special applications, the element in all standard WESTON Industrial Thermometers is a multiple helix as illustrated above. Why the more costly multiple, instead of the single, helix? Just one reason. WESTON's twenty years experience producing bi-metal thermometers for industry has furnished convincing proof that the shorter, non-sagging multiple helix provides better accuracy, over longer periods. And while it provides other advantages, the one thing most thermometer buyers demand is long-term dependability. You get it, in extra measure, in WESTON Thermometers with multiple helix. WESTON Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.
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Industrial Notes

NEW FACILITIES

Arthur D. Little, Inc., Cambridge, Mass.–Midwest liaison office in Chicago, located in the Board of Trade Bldg., will assist the firm in expanding its services in the Illinois area.

Stanford Research Institute – New branch office in Phoenix, Ariz., will serve as headquarters for a study of the economic and development problems of the Southwest.

The Atomic Center for Instruments & Equipment, Inc.–New sales department to handle British-made nucleonic and radiological instruments and equipment has been established in New York.

Reliance Electric and Engineering Co., Cleveland, Ohio–A direct factory sales office in San Francisco will serve regions of California and Nevada as a part of the firm's expansion in the field of engineering and technical service. The firm has also opened a sales office in Duluth.

Farr Co., Los Angeles–A southern division sales office in Memphis, Tenn., will serve district consumers of the firm's air filtration equipment.

Atlas Mineral Products Co., Houston, Tex.–A Thermoplastic Structures Division has been formed as a part of the expansion of Atlas in the extrusion of pipe and the fabrication of plastic structures.

Sinclair Refining Co.–Marketing division has been established to handle the sale of petroleum products and will be known as the Process Material Division. The division will also be responsible for the development of new petroleum products to serve the process industries.

Universal Detergents, Inc., Long Beach, Calif.–Eastern sales office in New York's Graybar Bldg. has been established with Berkshire Chemicals, Inc., as eastern distributor. In addition, the firm has appointed Cole and DeGraf, San Francisco chemical jobbers, as a California distributor.

Standard Oil Co.–A combination district office, warehouse and maintenance building in Chillicothe, Mo., to house Standard's products pipeline department as well as its maintenance crew.

Continental Can Co.–New Shellmar Betner Flexible Packaging Division is the result of combining Continental's two recent acquisitions–the Benjamin C. Betner Co. and Shellmar Products Corp.–into a single unit.

Farrand Optical Co., Inc.–West Coast engineering office opened by this designing and manufacturing firm in the field of electronic and scientific instruments.

Quaker Rubber Corp., Division of H. K. Porter Co., Inc., Philadelphia–New stock-carrying factory warehouse and sales office in Los Angeles to provide better service, in the Southern Pacific area, for consumers of their industrial rubber conveyor and transmission belting.

Westinghouse Electric Corp., Pittsburgh–Two-story building, as a part of an expansion of activities at the mica plant in Irwin, Pa. Part of the new facility will be used for storage purposes and the rest will be devoted to the manufacture of molded insulating parts.

NEW LOCATIONS

Trane Co., LaCrosse, Wisconsin, has relocated two sub-offices of its Greensboro, N. C., sales office. The Charlotte office will be located at 531 Northgate Ave.; the Raleigh office, at 510 Rose Lane.

General Mills' Chemical Division has moved its Chemical Products Sales Department from Minneapolis to Kankakee, Ill. Purchase of all raw materials will be handled at the new office. The Kankakee plant produces a line of polyamide resin materials.

Sterling Electric Motors, Inc., Los Angeles, has changed the location of the company's Cincinnati office. The new address is 2904 Woodburn Ave., Cincinnati 6, Ohio.

NEW REPRESENTATIVES

Acme Welding, division of The United Tool & Die Co., West Hartford, Conn., has chosen Transmission Equipment Co., Inc., an engineering firm specializing in heavy machinery, equipment and components, as exclusive sales agents for most of the United States and Canada.

Lippmann Engineering Works has appointed the Highway Equipment Co., Harrisburg, Pennsylvania as a distributor for its crushing, screening, and conveying machinery.

Great Lakes Solvents, Inc., Chicago, has selected Pioneer Chemical Associates, Denver, to market its new agricultural chemical—Alphenol.

Beckman & Whitley Inc., San Carlos, Calif., has named the G. E. Moxon Sales Co., San Mateo, Calif., as factory representative for Northern California in its line of instruments for industrial air-pollution work.

Hercules Powder Co., Wilmington, has designated Central Solvents & Chemicals Co., Chicago, as a distributor of its chlorinated paraffins sold under the name "Clorafin."

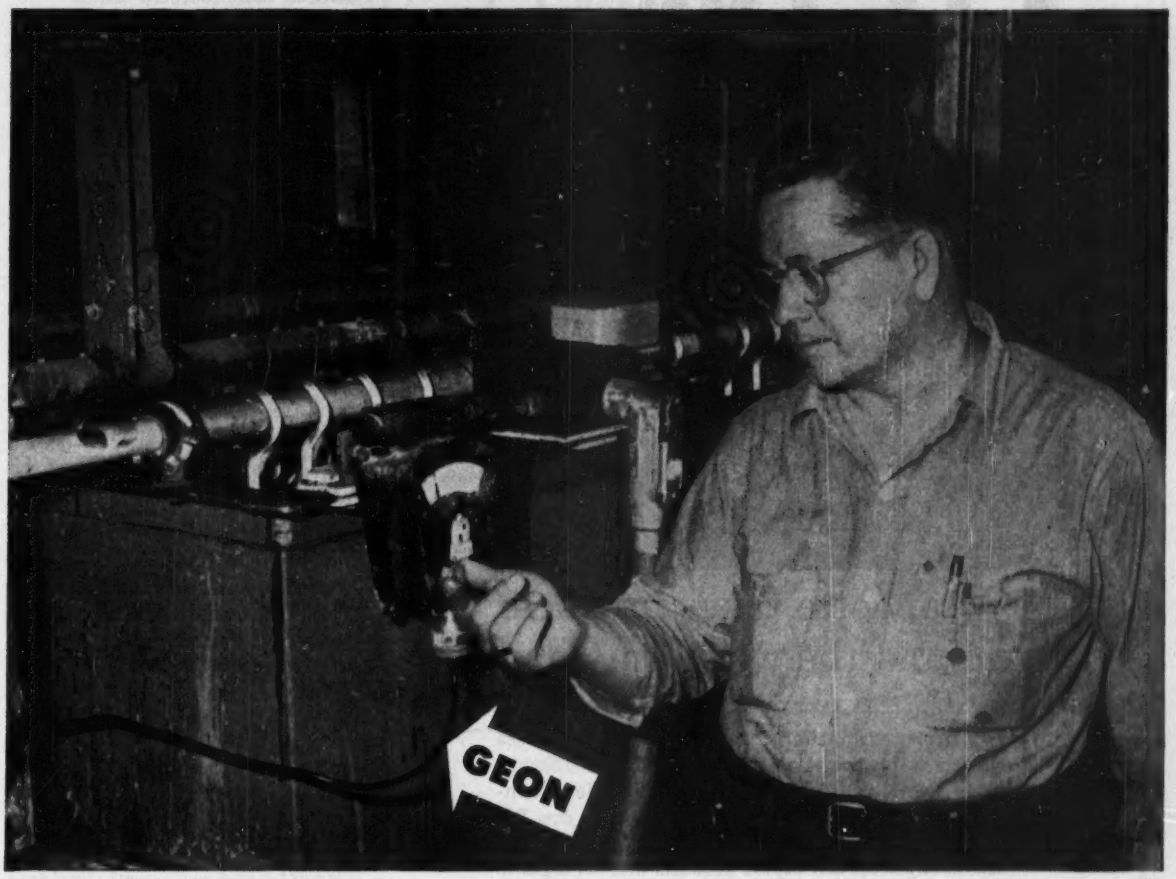
Mission Mfg. Co., Houston, has chosen the R. E. Chase Co., Tacoma, Wash., to distribute its centrifugal pumps to chemical plants, refineries and paper mills in the northwest.

Alloy Precision Castings Co., Cleveland, has named Industrial Products Sales, Inc., as field sales engineers for the states of Ohio and Michigan handling Alloy's castings, forgings and welded steel tubing.

C. B. Hunt & Son, Inc., Salem, Ohio, manufacturers of Quick-As-Wink

Another new development using

B. F. Goodrich Chemical *raw materials*



B. F. Goodrich Chemical Co. does not coat these controller parts. We supply only the Geon raw material.

TEMPERATURE CONTROLLER PARTS PROTECTED FROM ACID!

YOU need a concentrated phosphoric acid solution to reveal cracks, etc., in defective jet engine blades—but this can mean trouble for the temperature regulator controlling the acid bath.

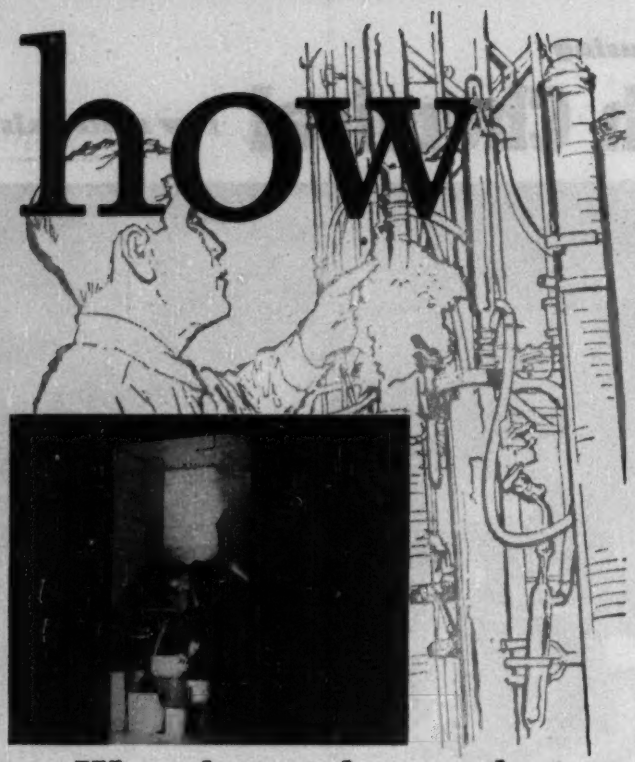
The bulb and capillary of the regulator is immersed in the bath. Formerly, these ordinary stainless steel or lead-coated elements couldn't stand the acid; they would last two or three months and short out.

The engineers tried coating these elements with a plastisol made from Geon paste resin. It works perfectly—the plastic coated parts show no deterioration after a year's steady use!

This example may give you an idea for developing or improving more saleable products. For Geon-based plastisols—and other Geon resins, latices and compounded plastics—have many applications. They may be used in coating, dipping, casting or molding operations to provide resistance to many chemicals, oil, grease, heat, cold and abrasion. We'll help you select the Geon material best suited to your needs. For technical information, please write Dept. GE-12, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable

GEON polyvinyl materials • HYCAR American rubber • GOOD-RITE chemicals and plasticizers • HARMON colors



Wyandotte takes products around the world in a day

To sell chemicals around the world, you've got to be sure they'll remain saleable and stable under all climatic conditions. Wyandotte Chemicals Corporation makes certain in controlled-temperature-and-humidity rooms built into its new Research Center at Wyandotte, Michigan.

Research engineers can expose products and packages to years of specific climatic conditions in a matter of hours and minutes. They can hold temperature and humidity constant, or vary them on a predetermined cycle. Conventional heating and cooling units deliver temperatures ranging from 140°F. to 25°F. Humidity is controlled by Kathabar equipment, which delivers relative humidity ranging from 80% to 1.3%.

Kathabar's precision control of humidity has helped industry not only in laboratory applications, but also in the processing, packaging, and storage of many products. With Kathabar, you can literally manufacture any RH on earth.

See us in Booth No. 54 at the "Chemical Show." We'll be glad to talk over *your* humidity and low temperature problems with you.

Kathabar
HUMIDITY CONDITIONING

SURFACE COMBUSTION CORP., TOLEDO 1, OHIO
ALSO MAKERS OF
Surface INDUSTRIAL FURNACES *Janitrol* AUTOMATIC SPACE HEATING

INDUSTRIAL NOTES, cont. . .

air and hydraulic control valves, has appointed Alfred Halliday of Louisville, Ky., as sales representative in most southern states.

Union Bay State Chemical Co., Inc., Foreign Trade Division, Cambridge, Mass., has selected the Alfa Rubber Corp., New York, as representative for its line of solvent cements, coatings, polymers and other industrial chemicals.

A. O. Smith Corp., Milwaukee, has named the U.S. Steel Corp., Supply Division, Chicago, as distributor for its welding products in the West Coast area.

G. C. Wilson & Co., Chatham, N.J., designers and manufacturers of electronic timers, have appointed The Satullo Co., Cleveland, as representative in the surrounding area.

Rheinhuette, Wiesbaden, Germany, has chosen Neumann & Welchman, New York, as sole U.S. representative of its line of heavy duty precision regulating acid and chemical valves.

NEW LINES

Chemical Products Corp., East Providence, R. I.—Plastisol, to be sold under the trade name of Chem-O-Sol, through the purchase of all formulas and equipment developed by the previous manufacturers, Stoner-Mudge, Inc., Pittsburgh.

Eclipse Fuel Engineering Co., Rockford, Ill.—Solenoid valves will be added to the firm's line of combustion equipment and controls through the purchase of Solenoid Valve Division from Wheaton Engineering Co., Wheaton, Ill.

Arizona Chemical Co., owned jointly by American Cynamid Co. and International Paper Co.—Terpene products, in addition to its line of tall oil derivatives, will now be handled by the firm and will be known as the acintene line of crude and refined sulfate turpentine.

Turbine Equipment Co., New York—Hynes industrial electric heating equipment will be produced by the firm's newly formed Hynes Electric Heating Division. Lee P. Hynes,

who developed these tubular, multi-pass, pipe tracer and electric heaters, will be retained as consulting engineer.

NEW NAMES

The Neville Co., Pittsburgh, Pa., has changed its corporate name to the Neville Chemical Co. in order to more readily identify the scope of their products and service.

Ludlow-Saylor Wire Co., St. Louis, producers of industrial wire cloth, has decided upon a name change. The firm will now be known as the Ludlow-Saylor Wire Cloth Co.

Builders Iron Foundry will be known as B-I-F Industries, Inc. The firm has been a pioneer in the development of a wide variety of equipment employed in metering, feeding and control in water filtration plants and in many processing industries.

NEW COMPANIES

Tennant (Peru) S. A. will devote its main activities to the export and import of ores and concentrates, industrial chemicals and other raw materials for industry, serving the West Coast of South America. The firm is a subsidiary of C. Tennant, Sons & Co., New York.

Process Plants Service, Inc., Elizabeth, N. J., will be engaged in the buying and selling of used chemical and process equipment, in the fabrication of new stainless steel process equipment and in plant dismantlement and demolition. The firm was formed by Dr. S. A. Savitt, formerly technical director of Consolidated Products Co.

R-S Furnace Corp., subsidiary of Hardings Co., Inc. Before its incorporation, the unit was known as the furnace division of R-S Products Corp. The new corporation will continue its usual activities in the production of furnaces used in the heat-treating of steel and nonferrous materials.

Pfaudler Inter-American Corp., a wholely owned subsidiary of the Pfaudler Co., N. Y., will handle all export business of the parent company to Central and South America, the West Indies and Canada.

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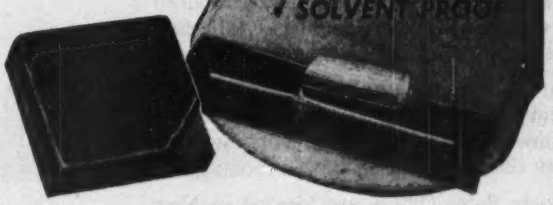

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THE CEILCOTE COMPANY
4832 Ridge Road, Cleveland 9, Ohio

Send for technical data on its application, corrosion resistance properties

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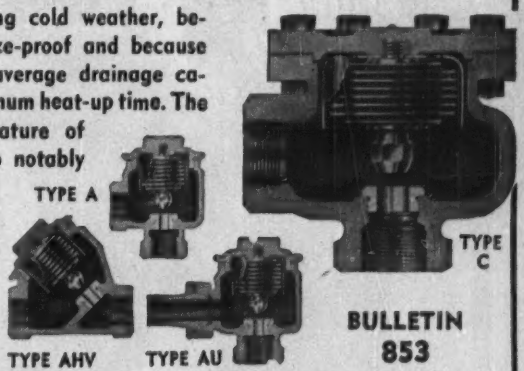
Freeze-Proof Steam Traps

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Types for every plant use. Size ¼" to 2"; pressure to 250 lbs.



BULLETIN 853

206 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

Alco speeds progress in

Answers to

Alco

PROGRESS today in the power, processing and construction industries frequently depends upon new and varied types of heavy metal equipment.

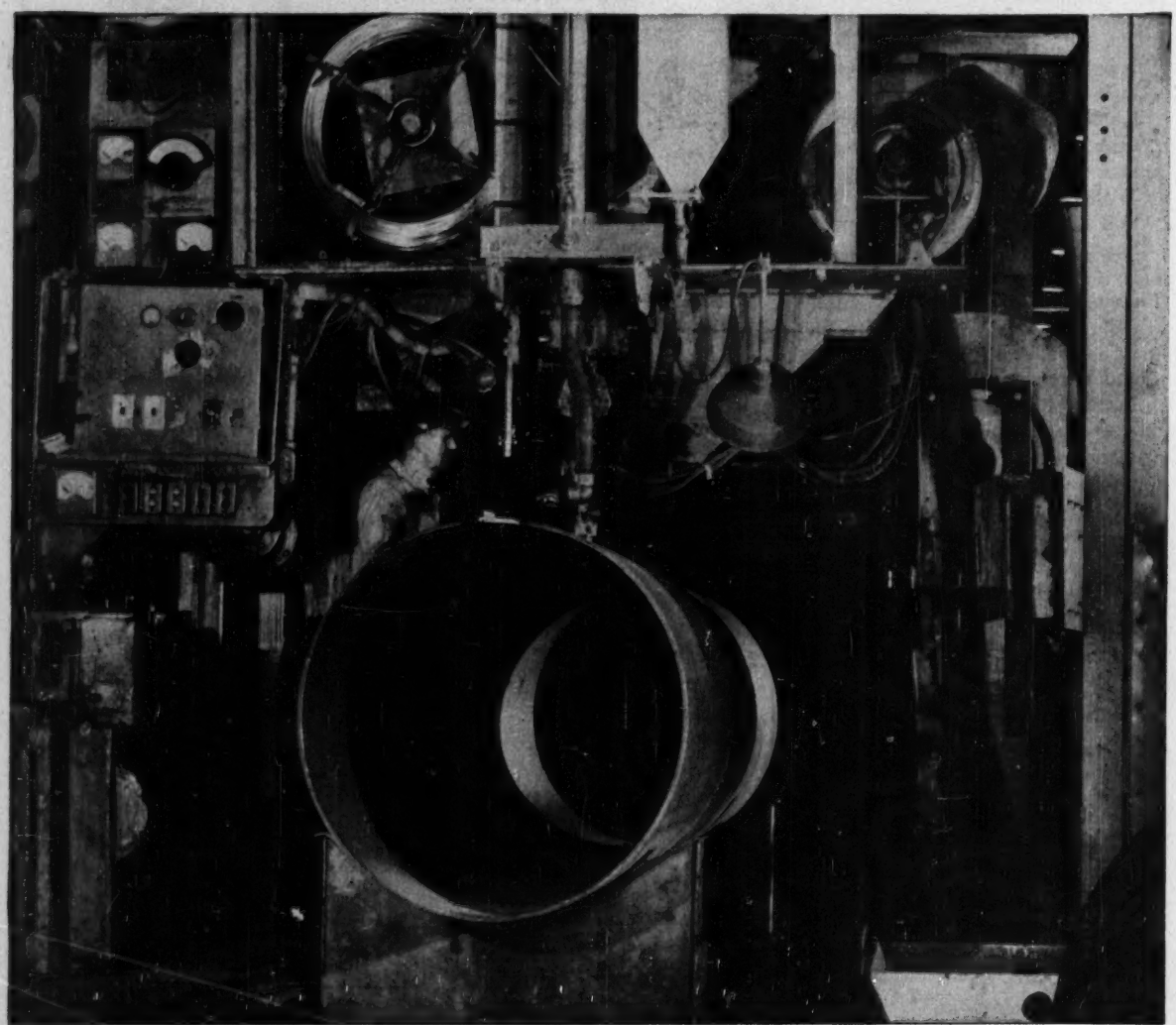
Designing and building this equipment has long been an Alco specialty. From Tulsa to Trieste, from Pittsburgh to Palembang, Alco products ranging from 4-in. welded steel pipe to mammoth pressure vessels are giving outstanding service in all types of industrial installations.

This wealth of experience—applied by skilled engineers and craftsmen working with modern facilities—enables Alco to design and fabricate heavy equipment to meet rigid specifications.

Select your toughest heavy-equipment problem —then send it to your nearest Alco Products Sales Engineer. He'll quickly show you how Alco can produce the answer you've been looking for.

Alco Products Sales Offices are located in New York, Chicago, Dunkirk, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

ALCO'S MODERN PRODUCTION FACILITIES, designed to handle economically many difficult metal-fabricating operations, include this automatic submerged-arc welding machine. Welds made on this machine must pass the most rigorous leak tests ever devised for commercial welding.



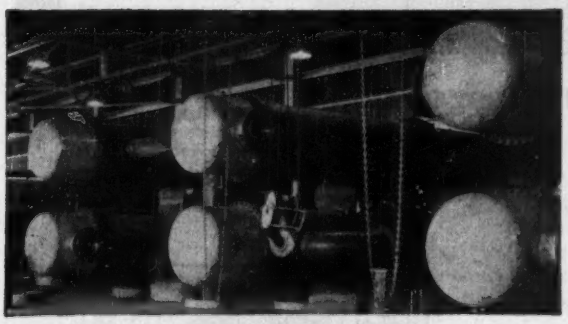
power and petroleum, chemicals and construction, with...

New Industrial Problems

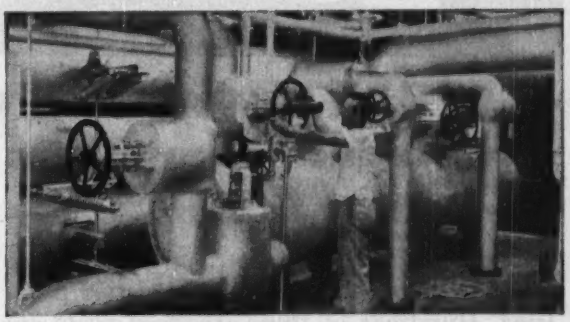
ALCO

ALCO PRODUCTS DIVISION

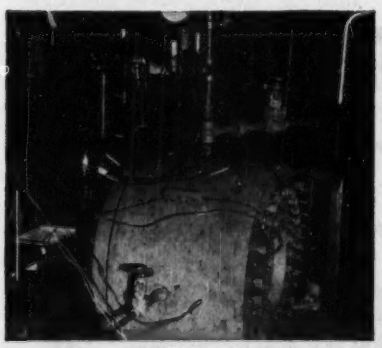
AMERICAN LOCOMOTIVE COMPANY • DUNKIRK, NEW YORK



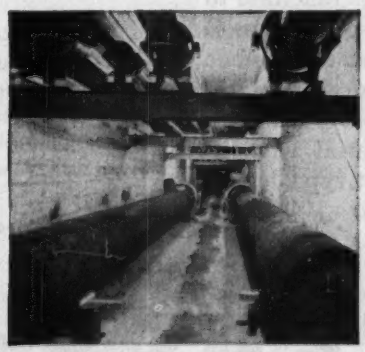
CUSTOM-BUILT HEAT EXCHANGERS ready for final piping in Canadian Chemical Company, Ltd.'s $55 million plant now under construction near Edmonton, Alberta. These units are among the more than 200 special reboilers and heat exchangers being supplied to the new Canadian plant by the Montreal Locomotive Works, Ltd., an Alco affiliate.



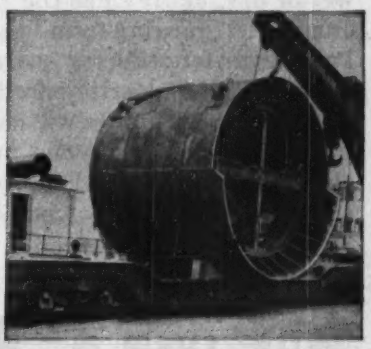
ALCO FLEX-TUBE EVAPORATORS incorporating many new features help boost efficiency at Carolina Power and Light Company's new 150,000 kw plant at Goldsboro, N. C. These specially designed Alco units produce vapor containing one part per million or less of mineral solids. Make-up to the system has been found to be less than one-half of one per cent.



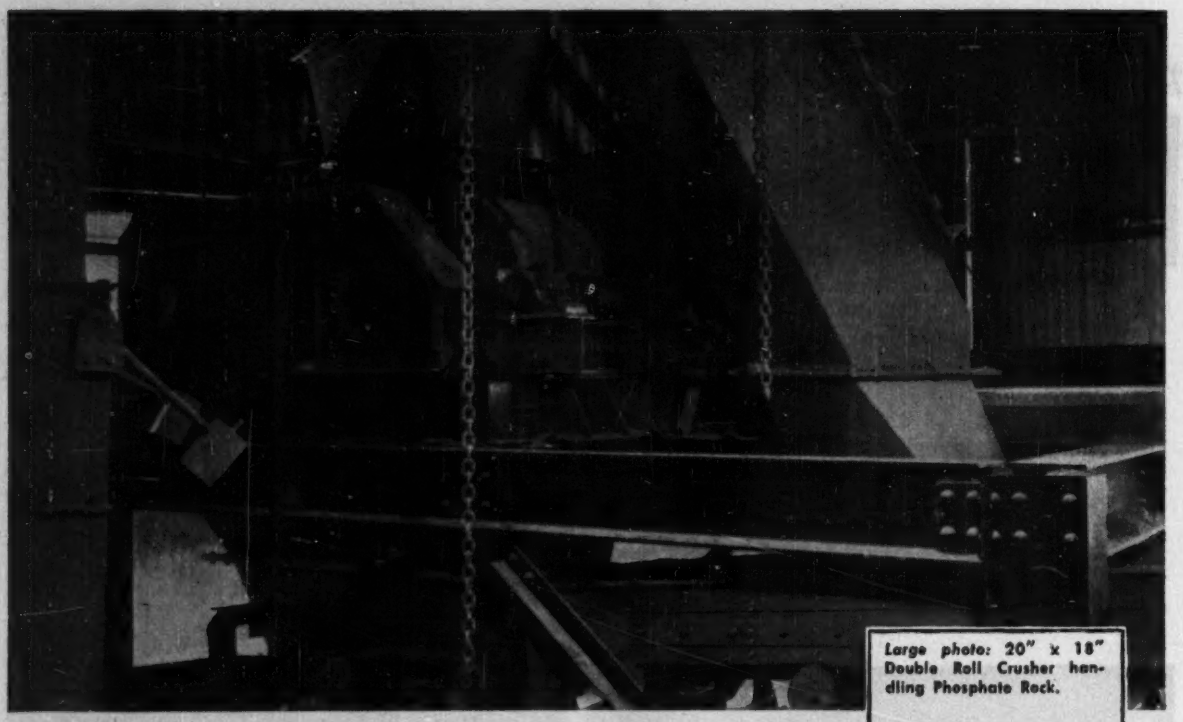
NEW HIGH-PRESSURE CLOSURE, shown here during high-temperature tests, is typical of the many heavy-equipment improvements developed by Alco engineers for service throughout industry. (Reprints of article, "Engineering Development of Alco's New High-Pressure Closure," available upon request.)



ALCO WELDED STEEL PIPE was furnished for the chilled water lines in the U. S. Government's new $4½ million walk-through tunnel, part of a Capitol Power Plant improvement project, now under construction at Washington, D. C. The 30-in. main lines (on tunnel floor) total about 9,280 ft., branch lines about 1,200 ft.



GIANT TUNNEL SHIELDS illustrate the variety of special heavy-metal equipment designed and fabricated by Alco for power, petroleum, chemical and construction companies the world over. Other items built by Alco to meet strict specifications range from tar stills to stripping towers, cement kilns to jet-engine containers.



Large photo: 20" x 18" Double Roll Crusher handling Phosphate Rock.

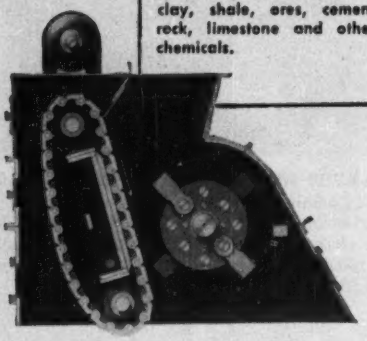
Cross-section: Jeffrey Mud Hog Crusher with traveling breaker plate for handling wet, sticky material such as clay, shale, ores, cement rock, limestone and other chemicals.

JEFFREY crushers and pulverizers solve reduction problems from Alum to Zinc

Jeffrey's Pulverizers and Crushers are the ideal solution to material reduction problems. Hundreds of these standard units are giving efficient, economical service to leaders in your industry. Each is backed by Jeffrey's unequaled experience in this field. Each includes many features only Jeffrey provides.

Whether your material is large or small, wet or dry, Jeffrey has the right machine to crush it . . . ranging from heavy-duty Type B Pulverizers for reducing quarry-size limestone . . . to Junior Pulverizers for laboratory work.

Our laboratories will make a crushing or pulverizing test on your material without charge and recommend the exact type Jeffrey equipment for your requirements.



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Rigid Hammer Shredders	Metal Turnings Crushers
Impact Type Crushers	Mud Hog Crushers

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Chemical Engineer's Bookshelf

Edited by Lester B. Pope

Grand Old Man

LEO UBBELOHDE, SEIN WIRKEN. Published by Verlag G. Braun, Karlsruhe. 164 pages. Price DM 12.

One of the grand old men of German chemical technology, Prof. Dr. Leo Ubbelohde, director of the technical chemical institute of the Technischen Hochschule of Berlin, celebrated his 75th birthday Jan. 4, 1952. To commemorate this occasion and pay honor to his pioneering contributions, many of his students, colleagues and friends collaborated in preparing this beautiful little book. They depicted his life work in a series of 30 brief essays on his notable contributions to the technology of petroleum, gas and coal, paper and textiles. Special attention is given the development of the oil viscosimeter and related apparatus for which he is internationally famous. A notable feature is the inclusion of 11 letters of tribute from outstanding chemists in Germany, England, France, Switzerland and the United States.—*SDK*

For Reactor Operators Only

THE ELEMENTS OF NUCLEAR REACTOR THEORY. By S. Glasstone and M. C. Edlund. D. Van Nostrand Co., New York. 416 pages. $4.80.

Reviewed by Arthur L. Levy

According to the authors "this book is intended as an introduction to the subject of nuclear reactor theory for the use of physicists, engineers and others who are being brought into the reactor program for the first time." The first four chapters serve as an introduction to nuclear physics and give a good account of nuclear structure and reactions, the production of neutrons and the fission process. The rest of the book is concerned with the diffusion and slowing down of neutrons and with the problems of reactors of various kinds, their behavior, their maintenance and control.

The authors go into great detail in solving the equations of reactor theory, and a very large part of the book is devoted to the applied mathematics of the reactor. It doesn't make very interesting reading, shows no new principles, and will probably be of interest only to those actually concerned with operating a nuclear reactor; this latter evidently was the authors' intent as stated in their preface.

Anyone interested in a description of the specific practical problems that arise in reactor technology will do well to read the introductions at the beginning of each chapter and to omit the mathematical solutions that follow.

New Gmelin Volumes

SULFUR. System No. 9, Section A2 of the Eighth Edition of Gmelin's Handbook of Inorganic Chemistry. Verlag Chemie, Weinheim, Germany, 1952. Available through Walter J. Johnson, Inc., 125 E. 23 St., N. Y. 10, or Stechert-Hafner, Inc., 31 E. 10 St., New York. $35.30.

Reviewed by Max Wulfinghoff

This 450-page volume critically reviews present knowledge of the technology of sulfur and its compounds, their colloidal behavior and physiological effects. The geochemistry of sulfur, its occurrence on extraterrestrial bodies, available deposits of sulfidic ores, occurrence of the elements in the hydrosphere, in industrial fuels, in plants and in living organisms are discussed. The dressing of sulfur ores, and the recovery of the element from gases, and the production of sulfuric acid, sulfur trioxide and of chlorosulfonic acid and patent information come next. The final chapter presents facts on colloidal sulfur, and the physiological aspects of the handling of sulfur and its compounds and also treats the questions of clinical and industrial therapy.

Chemical and electrochemical aspects will be covered in volume A3 which is scheduled to appear at the end of the year.

► **Section B1** of this work comprises 372 pages and 75 graphs, and its price is $29.40. It deals with the hydrites and oxides of sulfur. Particular attention is given to the equilibrium and reactions of hydrogen sulfide. Deuterium sulfides and the hydrogen polysulfides follow with oxides next. Combustion reactions and equilibria are discussed fully for SO, S_2O_2, S_2O_3 and SO_4.

As is customary with the authors of the series, this is an extremely well documented work, brought up to date with the utmost care. Typography and illustrations are clear and very readable, and the presentation is brief and to the point.

A Coherent Story

OXIDATION OF METALS AND ALLOYS. By O. Kubaschewski and B. E. Hopkins, Academic Press, New York. 239 pages. $6.

Reviewed by N. Hackerman

The authors' stated purpose was to write a book appraising the existing state of the science in regard to the oxidation of metals and alloys and to do so in the interest of workers who fall between those who are wholly concerned either with the theoretical aspects or with the practical aspects of the field. They accomplished their purpose and did it well. The book is written in a clear style which makes the sometimes difficult material quite readable.

Using four basic units as a guide, Kubaschewski and Hopkins put together a coherent story which includes material from the research literature extending up through 1952. They start with a discussion of some of the important variables pertinent to the reactions under consideration; follow this with a section on the wide variety of experimental techniques used in the researches; then discuss Wagner's widely accepted mechanism for reactions following the parabolic rate law, and several less firmly established hypotheses relating to other rate equations; and finally tie these concepts to presently available experimental results, in so far as this is possible.

There is included a wealth of references to the original literature. The authors examined the literature critically and either used fully creditable

AIR POLLUTION

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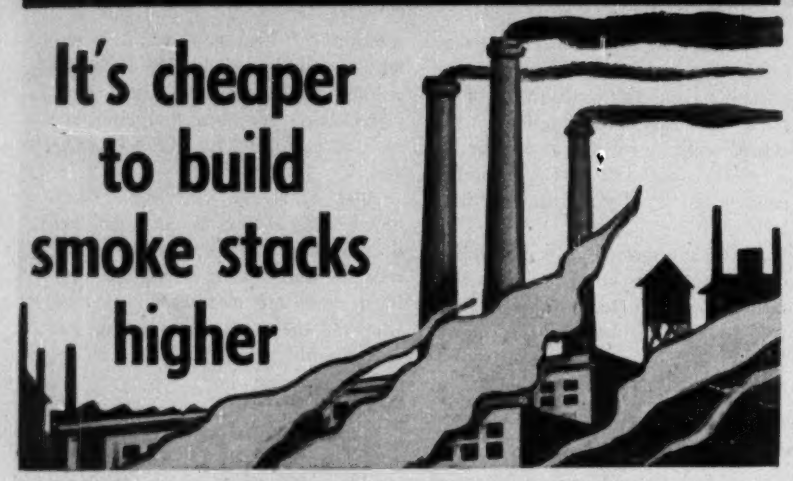

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Why did a smelter in the southwest first build its smoke stack 200 feet high . . . then raise it to 350 feet . . . and then raise it again to 455 feet to eliminate SO_2 pollution?

Over the years they had learned more from the scientific progress in "stack meteorology" as a practical way to eliminate pollution at ground levels.

They learned the hard way. You can do it the easy way.

Basic Patterns of Smoke Behavior

Meteorologists studying smoke behaviour under almost all kinds of turbulence, temperature and humidity conditions have come up with some basic answers for forecasting smoke behaviour.

This knowledge applied to your plant location and your air pollution problem will help guide you to the solution on a broad level.

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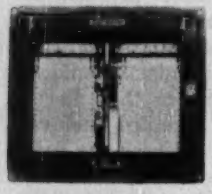

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data or state that they are uncertain of the reliability of the data, when that is the case. Not the least important item in the book is the information contained in the eighteen tables included. Here again the tone of the work permits the reader to feel that he is looking at information whose value has been carefully assessed. The authors frequently point out areas in which experimental work is unsuitable or is lacking.

It is true that there are some to whom the descriptive development of the mathematical relationships will not appeal and there are others who will feel that they do not get enough of applicable value. However, even both of these groups can find much of usefulness in the book. For the former there is a collection of quantitative information which will make it easier for them to compare their theories with practice; for the latter there is a basis for the insight which should be a very considerable aid to the practice of the art.

The cover, binding, figures and tables are all satisfactory. A somewhat larger type size might have been advantageous but that is a matter of purely personal opinion. The book is relatively free of typographical errors.

"Oxidation of Metals and Alloys" should be useful to all of those interested in dry oxidation, in heterogeneous kinetics, in surface chemistry and in the broad field of corrosion.

Important Data

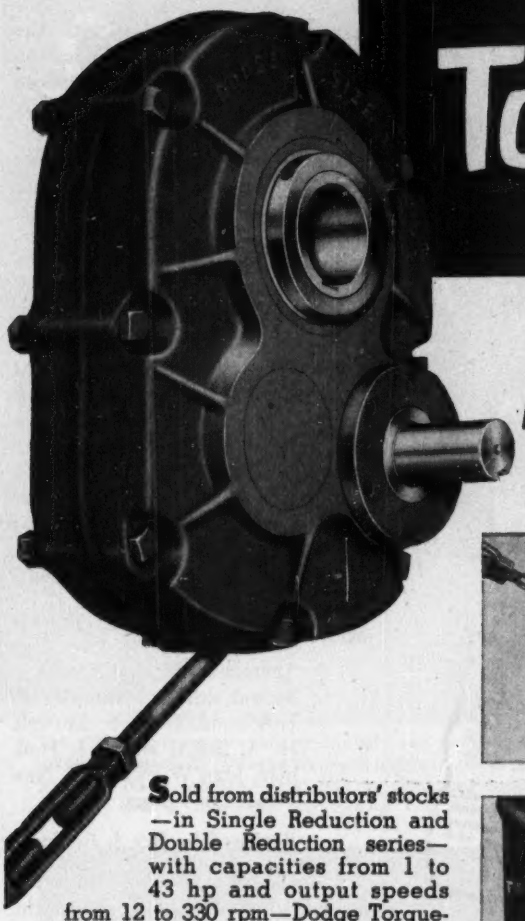
METAL DATA. By S. L. Hoyt. Reinhold Publishing Corp., New York. 526 Pages. $10.

Reviewed by Byron Zolin

"Metal Data" is an enlarged and revised edition of S. L. Hoyt's previous work, "Metals and Alloys Data Book." It contains an abundance of reliable data on the properties of metals and their alloys. The information is presented in 564 tables and 173 figures, and almost all descriptive matter is omitted so that considerable factual matter is covered in a relatively small space. A detailed index facilitates the finding of information and it would be beneficial for the readers to become thoroughly familiar with the index.

This style of presentation is designed to fill the needs of technical

Torque-Arm



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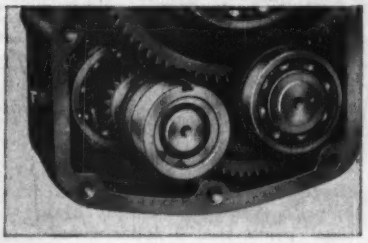
Provides instant, positive protection for driven machines, motors and reducer itself. Automatically (1) loosens the belts, (2) cuts off power, (3) gives a warning.



TORQUE-ARM BACK STOP
Available from stock when required. Easily installed—sealed inside reducer housing. Simple, positive action prevents reversal.

Sold from distributors' stocks—in Single Reduction and Double Reduction series—with capacities from 1 to 43 hp and output speeds from 12 to 330 rpm—Dodge Torque-Arm is the new and modern idea in speed reducers.

No special engineering required. No foundation to provide. No flexible couplings. No sliding base. No lining up difficulties. No expensive installation. Stock Taper-Lock sheaves prescribed for each job to provide desired speeds. Application to other machines is practical and easy.

Unit is driven through any V-Belt Drive. Torque-Arm, fastened to any fixed object, anchors the reducer unit. Turnbuckle provides fast and accurate adjustment of belt tension.

Standardize on Torque-Arm, the speed reducer that saves you money.

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CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory-trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone book.

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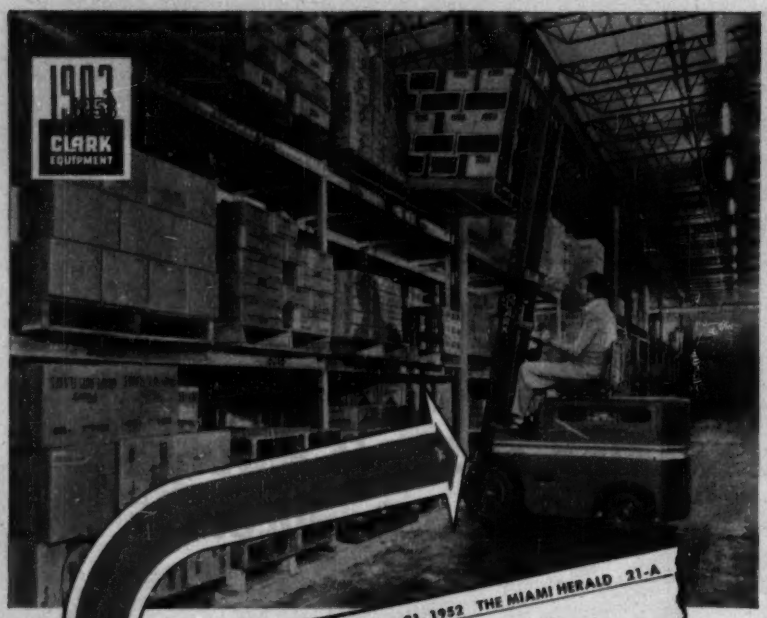

Tuesday, October 21, 1952 THE MIAMI HERALD 21-A

Financial News

Winn & Lovett's Earnings On Rise

By United Press

JACKSONVILLE—Winn & Lovett Grocery Co. reported for the quarter ended Sept. 20 sharply higher earnings, reflecting economies achieved through mechanization in warehousing and merchandise handling.

Net for the first quarter of the current fiscal year, totaled $600,597, or 44 cents a share on comison, compared with $409,342 or 29 cents in the same quarter last year. Net sales of $41,851,672 compared with $36,763,499.

As of Sept. 20, the food chain had in operation 181 retail outlets [illegible] in Florida.

How To Make More Money

THIS NEWS CLIPPING suggests one way to make more money. Winn & Lovett's "sharply higher earnings" prove that a dollar saved is *still* a dollar earned.

"Mechanization" saved more than 50% of Winn & Lovett's handling bill. "Mechanization" in this case means a fleet of CLARK fork trucks and towing tractors, operated on a well-planned schedule. These savings, together with increased retail volume and retail operating improvements, resulted in "sharply higher earnings," and the company made financial headlines.

The moral of this story is this:

Call in your local CLARK dealer to discuss ways to cut handling costs. That's what Winn & Lovett did, and look what happened!

CLARK ELECTRIC, GAS, DIESEL, L.P. GAS FORK TRUCKS
AND POWERED HAND TRUCKS • INDUSTRIAL TOWING TRACTORS

INDUSTRIAL TRUCK DIVISION • CLARK EQUIPMENT COMPANY • BATTLE CREEK 5, MICHIGAN

Please send: ☐ Condensed Catalog ☐ Have representative call ☐ Driver Training Movie

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[illegible] INDUSTRIAL TRUCK PARTS AND SERVICE STATIONS IN PRINCIPAL LOCATIONS

personnel already familiar with the principles of metallurgy. Interpretation and understanding the limitations of the data are important prerequisites for the successful utilization of the book. This subject is thoroughly discussed by the author in the preface and should be read by those who use this book.

The 12 chapters include most of the important data concerning the room and elevated temperature properties of the wrought and heat treated steels, cast steels and irons, wrought and cast stainless steel, super-alloys, cast and wrought non-ferrous alloys, and miscellaneous metals from antimony to zirconium. The data on heat-treated steels have been increased in scope, and recent information about the super-alloys, molybdenum, titanium and zirconium is also included.

Modernized Stand-By

APPLIED INORGANIC ANALYSIS. Second edition. By W. F. Hillebrand, G. E. F. Lundell, H. A. Bright and J. I. Hoffman. John Wiley & Sons, New York. 1,034 pages. $15.

Reviewed by Rex J. Robinson

For 24 years the first edition of this book has been outstanding in its field. Although this edition is very similar in plan and general appearance to its well-known predecessor, close examination shows that many changes have been made throughout the book.

Additions and deletions have been made to every chapter, and certain chapters have been significantly revised and rewritten. The aim of the book is still to describe only proved methods of separation and determination.

The impact of instrumentation on the field of analysis has been recognized by discussing very briefly the general principles of polarography, flame photometry, mass spectrometry, x-ray analysis, etc. to point out the applications of these special techniques. To keep the book from becoming unwieldly in size due to the various additions, Part V of the previous edition (analysis of soda-lime glass, bauxite and refractories) has been deleted. All of those who have an interest in analysis will welcome the modernization of this old stand-by of so many years. —*End*

Sulphuric acid plant modernizes

The Elliott motor-driven unit at the left was installed in 1948. It is rated 23,000 inlet cfm, with a differential pressure of 100 in. water. A later unit, at right, has equal capacity with a differential pressure of 130 in. water.

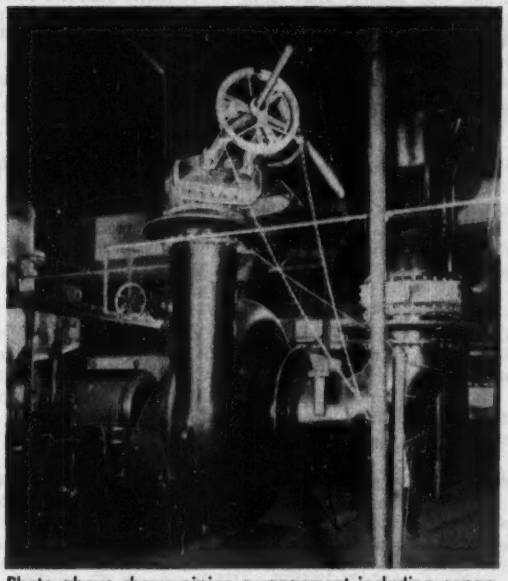


Photo above shows piping arrangement including expansion joints, shut-off valves and support for intake piping, all essential to a satisfactory blower installation.

with ELLIOTT *Centrifugal* BLOWERS

● In line with the majority of new sulfuric acid plants, as well as those bringing their equipment up to today's operating standards, the plant illustrated has, since 1948, installed several Elliott centrifugal blowers to replace units of positive displacement type.

These blowers must operate 24 hours per day; in fact, they are the key to the entire plant operation, actually regulating the process. In circumstances like these, the dependable performance of Elliott blowers is essential.

Elliott blowers are built complete with drive—motor or turbine—in the Elliott shops. For full details, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company

CENTRIFUGAL BLOWER DEPARTMENT

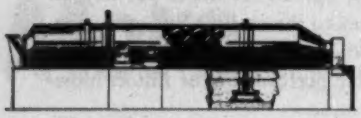
P3-4

DOUBLE SHELL DRYERS

SINGLE SHELL DRYERS

RUGGLES-COLES
Continuous
Rotary
Dryers,
Kilns,
And Coolers

ROTARY KILNS



ROTARY COOLERS

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Recent Books & Pamphlets

Subject	Summary	How to Order
Safety	A manual of safe working practices for distribution to employees as a reminder, and a convincer, of the need to work safely. Gives the whys and wherefores of each safety rule. 32 pages.	"Working Together for Safety." National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill. 20 cents to 7½ cents each, depending on quantity.
Applied Chemistry	Annual compilation of the literature on applied chemistry. Briefly discusses the major developments in some 42 fields as described in the 1952 literature. A fine starting point for a literature survey or a handy manual to keep you abreast of current developments. Complete subject and author index. 983 pages.	"Reports on the Progress of Applied Chemistry." Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. $6.50.
Corrosion	Number of papers on corrosion and the various ramifications of corrosion protection. 60 pages.	"Corrosion (A Series of Papers Reprinted from *Research*, Vol. 5, 1952)." Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. $1.75.
Thermocouple Tables	New reference tables for iron-constantan thermocouples, covering a temperature range from −310 to +1,600 deg. F. The new tables correspond closely to the properties of commercially available thermocouples and have been adopted as tentative standards by the Scientific Apparatus Makers of America.	"Iron-Constantan Thermocouple Tables." National Bureau of Standards, U. S. Department of Commerce, Washington 25, D. C.
Steam Coils	Standards for testing and rating steam coils. Includes definitions, description of apparatus, test procedure, calculations and method of representing results. 16 pages.	"Tentative Standard Code for Testing and Rating Steam Coils." Bulletin No. 200, Heating and Cooling Coil Manufacturers' Association, 2159 Guardian Building, Detroit 26, Mich.
Hot Water Coils	Tentative standards for testing and rating hot water coils. Includes definitions, description of apparatus test procedures, method of calculation and of representing results. 16 pages.	"Tentative Standard Code for Testing and Rating Hot Water Coils." Bulletin No. 201, Heating and Cooling Coil Manufacturer's Association, 2159 Guardian Building, Detroit 26, Mich.
Electrochemical Constants	Proceedings of the National Bureau of Standards Semicentennial Symposium. Thirty papers on the results of fundamental investigations in electrochemistry both here and abroad.	"Electrochemical Constants." National Bureau of Standards Circular 524, Government Printing Office, Washington 25, D. C. $2.
Glasses	First of a series of reports describing the electrical behavior of simple glasses. Defines the relationship between the dielectric constant, dissipation factor and composition of simple glasses. 27 pages.	"The Dielectric Constant and Dissipation Factor of Soda-Potassia-Silica Glasses at Frequencies of 1 to 300 Kilocycles at Room Temperature." Bulletin Series No. 411, University of Illinois, Urbana, Ill. 30 cents.
Soybeans	Report of a study made by three Department of Agriculture agencies on the economic effects of the adoption of new soybean processing methods and equipment upon farmers and processors. 46 pages.	"Economic Analyses Relating to Soybean Processing." Marketing Research Report No. 35, May 1953, U. S. Department of Agriculture, Washington 25, D. C. Gratis.

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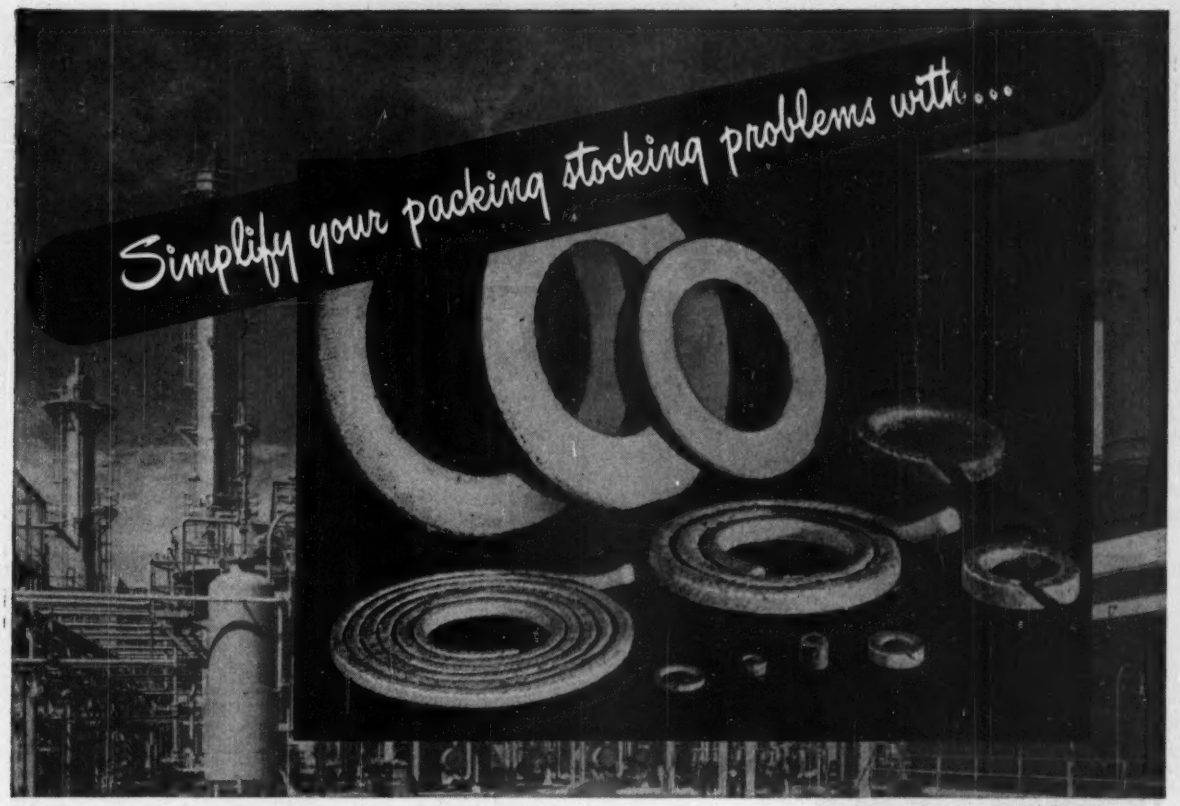

background photo courtesy of Shell Oil Company

J-M CHEMPAC—an asbestos-Teflon packing that withstands virtually ALL chemicals

THIS NEW Johns-Manville development combines the sealing action and heat-resistant characteristics of asbestos with the all-around chemical resistance of Teflon. Its base is strong, resilient asbestos fibers thoroughly impregnated with chemically inert Teflon.

The versatility of Chempac greatly reduces the number of packing styles needed for chemical equipment. Stocking presents no problem because its inert ingredients do not deteriorate.

Chempac can be recommended for packing pump rods or shafts, valve stems, agitator shafts, expansion joints, rotary filters and similar apparatus. It is outstanding in service against many acids, alkalies, caustic solutions, and solvents, at temperatures to 525° F.

Chempac Packing is available in coil, spiral and ring form for rod, plunger and valve stem service. Style Nos. 2011, 2012 and 2013 are made of white Canadian Chrysotile Asbestos. No. 2014 is made of blue African Crocidolite Asbestos. Johns-Manville also makes Chempac Gaskets, Nos. 117 and 138 of plies of asbestos cloth treated with Teflon.

Your Johns-Manville Packing Distributor can help you select the right Chempac Packing or Gasket for your application. For complete information write him or Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

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Johns-Manville PACKINGS & GASKETS

A synthetic soil conditioner has been announced which helps to control rain and wind erosion on construction sites, levees, rights of way and similar "bare ground" sites. Designed to stabilize aggregates on the soil surface, it helps to hold seeds and soil in place until vegetation cover takes over the job.

Deep-sea divers joined a small army of engineers and construction crews in driving over 42,000 piles at a riverside site for a Louisiana plant—to provide a stable foundation in mushy ground. Divers, working 40 feet down in the Mississippi River, were required to direct

placement of the concrete seal. We'll send you a 32-page illustrated book which tells how Kaiser Engineers is equipped to meet challenging problems—like this one at the nation's largest aluminum plant, which was producing metal in just 10 months.

A pocket pyrometer, now on the market, gives direct reading of temperatures up to 3,300 deg. F. Only six and one-half inches long, it weighs about five ounces, and is shaped like a miniature telescope.

Whether it's designing an oil refinery, building a porcelain enameling plant or laying out a site plan, Kaiser Engineers undertakes the job with assurance because of the variety of talent within the organization. Successful experience in a wide field of design, engineering and construction tells the story. Call or write: Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

RECENT BOOKS & PAMPHLETS, *cont. . .*

Subject	Summary	How to Order
Insulation	Report indicates that a satisfactory mineral-wool insulation can be made from Rhode Island meta-anthracite coal and limestone. A practical method of production is also described. 35 pages.	"A Slagging Gas Producer for the Production of Mineral Wool From Rhode Island Meta-Anthracite." Dr. T. S. Crawford, Director of the Engineering Experiment Station, University of Rhode Island, Kingston, R. I. Gratis.
Natural Resources	Four monographs on the physical and economic foundation of natural resources. Prepared by the Interior and Insular Affairs Committee of the House of Representatives. 33, 93, 78 and 206 pages respectively.	"Photo synthesis—Basic Features of the Process.", "The Physical Basis of Water Supply and Its Principle Uses.", "Underground Regions of the United States—Their Storage Facilities." and "Subsurface Facilities of Water Management and Patterns of Supply —Type Area Studies." Superintendent of Documents, Government Printing Office, Washington 25, D. C. 35 cents, $1., 60 cents and $1.50 respectively.
Powder Metallurgy	Up-to-the-minute commentary on the latest developments in powder metallurgy, one of the fastest-growing industrial techniques. Includes 11 papers on various aspects of the subject. 111 pages.	"Proceedings of the Ninth Annual Meeting of the Metal Powder Association." Metal Powder Association, 420 Lexington Ave., N. Y. 17, N. Y. $2.50.
Water	Last of a series of 9 preliminary reports giving factual data on the water supplies of the larger cities of the U. S. Covers New England cities. 80 pages.	"The Industrial Utility of Public Water Supplies in the New England States, 1952." Circular 288, U. S. Geological Survey, Washington 25, D. C. Gratis.
Pesticides	Compilation of existing information on pesticide toxicides and recommendations for adequate protection. Prepared for the World Health Organization. Includes extensive bibliography. 129 pages.	"Toxic Hazards of Certain Pesticides to Man." WHO Monograph Series No. 16, Columbia University Press, International Document Service, 2960 Broadway, New York 27, N. Y. $1.50.
Cocoa	Monograph dealing with the cultivation, preservation, processing and analysis of the cacao beans and of cocoa and chocolate products. A valuable reference for anyone concerned with processing this crop. 302 pages.	"Cocoa," by E. M. Chatt, Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. $8.50.
Turbulent Jets	Results of an investigation of the transport of heat, mass and momentum in turbulent jets. An effort to gain an understanding of the basic principles underlying the process. 88 pages.	"Transport of Momentum, Mass and Heat in Turbulent Jets." Bulletin Series No. 413, University of Illinois, Urbana, Ill. 75 cents.
Tin Research	1952 report on the status of research into the uses of tin. Describes new applications of tin and tin alloys. 16 pages.	"Report of the Tin Research Institute for 1952." Tin Research Institute, Inc., 492 West Sixth Ave., Columbus 1, Ohio. Gratis.
Thesis Abstracts	Abstracts of theses submitted by Case Institute students during 1952-53 school year. Theses cover both engineering and purely scientific subjects. 43 pages.	"Thesis Abstracts." Industrial Liaison Office, Case Institute of Technology, Cleveland, Ohio. Gratis.

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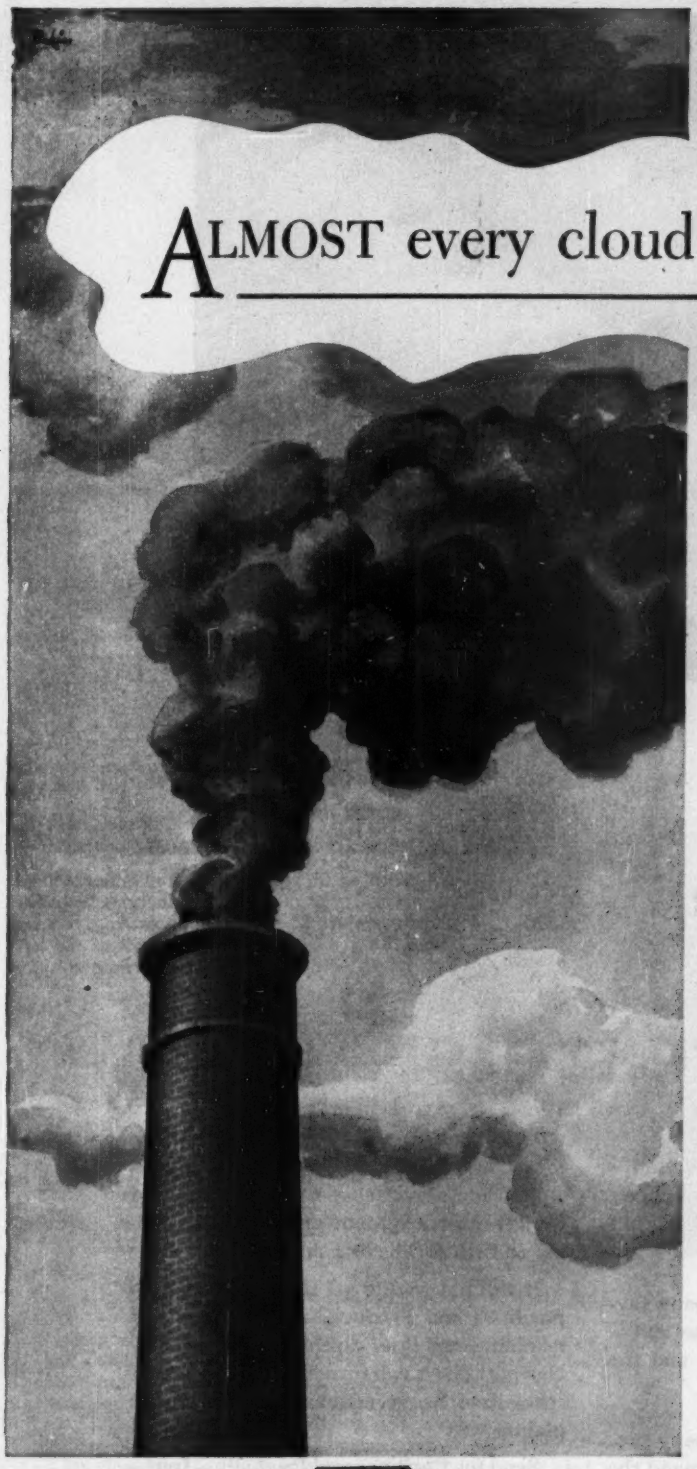

ALMOST every cloud has a silver lining

IN CASES where Koppers-Elex Electrostatic Precipitators can be used profitably, plants have at their disposal the most effective and efficient means known for preventing actual dollars-and-cents profits from 'going up in smoke.' It does this in any one of three ways:

FIRST—recovery of valuable materials entrained in process gases.

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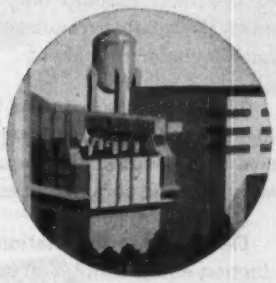
Koppers-Elex precipitators are designed, engineered, fabricated, erected, and guaranteed under one contract by the Koppers Company. For analysis and recommendations relating to your operation, submit details without obligation to: KOPPERS COMPANY, INC., *Precipitator Department*, 312 Scott Street, Baltimore 3, Maryland.



GUARANTEE: All Koppers-Elex precipitators are guaranteed to meet your specifications for efficiency or residual content.

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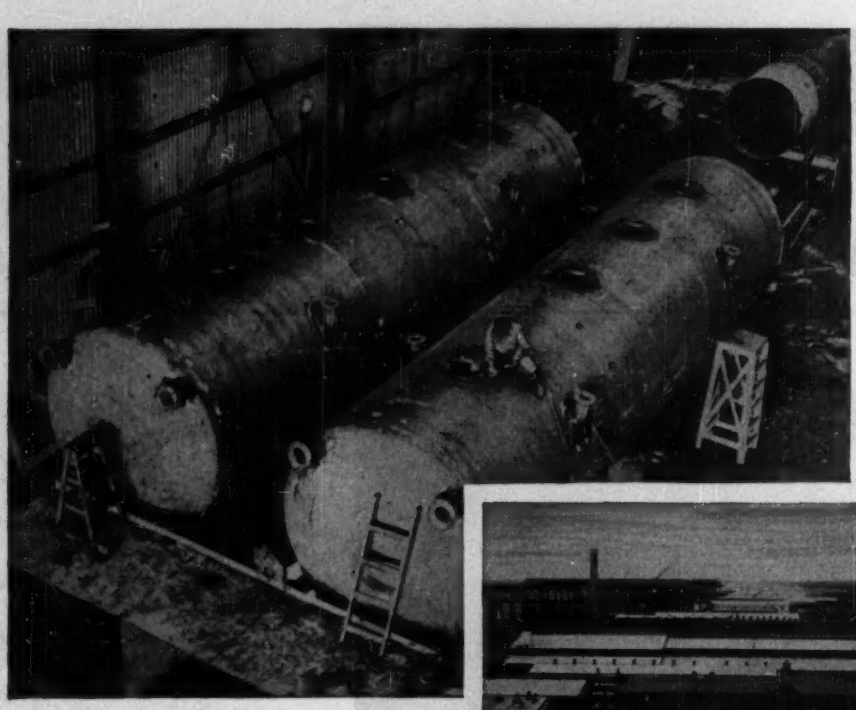

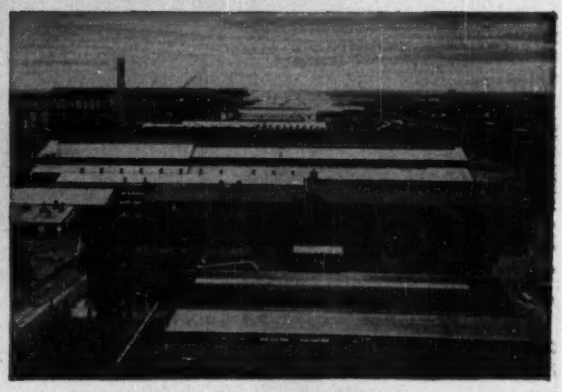

A Mile of Shops – Each shop is devoted to a special type of heavy production. Included are complete Machine Shops, casting, forging and other facilities which offer all of the advantages of the execution of the complete job.

A half mile of pressure vessels

These are two of seventy – over ½ mile – of 38½-foot vacuum tank casings built to meet the quality requirements of a well-known chemical maker.

The buyer also benefits from many savings made possible by Newport News extensive heavy fabrication equipment and the sixty years experience in using it.

Do you plan installations of heavy production equipment? You can command the services of Newport News for weldments of corrosion-resistant, alloy and clad metals in almost any size or shape, plus the required engineering background and complete welding and stress-relieving skills.

It will pay you to get the facts, shown in *Facilities and Products*. As you glance at its photos and brief captions, you'll see why Newport News can turn out – at low cost – specialized heavy equipment for chemical plants.

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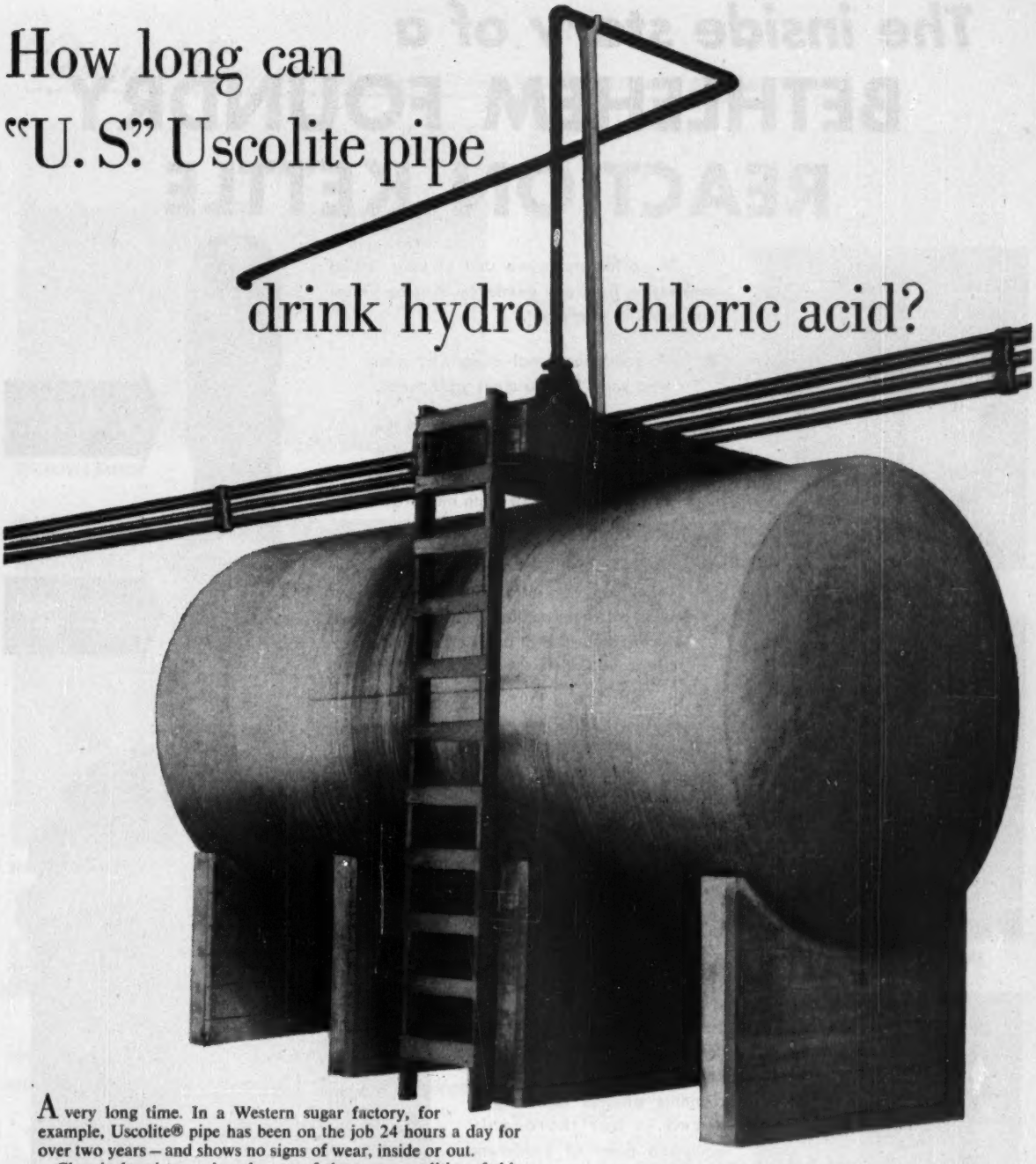
How long can "U. S." Uscolite pipe drink hydrochloric acid?



A very long time. In a Western sugar factory, for example, Uscolite® pipe has been on the job 24 hours a day for over two years – and shows no signs of wear, inside or out.

Chemical resistance is only one of the many qualities of this amazing thermoplastic pipe. Uscolite is also recommended for handling materials sensitive to contamination – because it is non-toxic and imparts no odors. It is very tough – thrives under the most severe conditions. It is easily cut and threaded in standard equipment and can be drilled and tapped, sawed and machined.

Developed by United States Rubber Company, Uscolite is used in every type of industry... and always with savings in cost, improvement in performance. Call on any of our 25 District Sales Offices, or write to address below.

Hydrochloric acid in this exterior supply tank is pumped up to the interior supply tank through Uscolite pipe. The inside of the pipe is unaffected by the acid, the outside is unaffected by the weather.

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The inside story of a
BETHLEHEM FOUNDRY REACTION KETTLE

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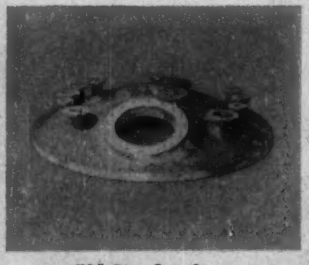
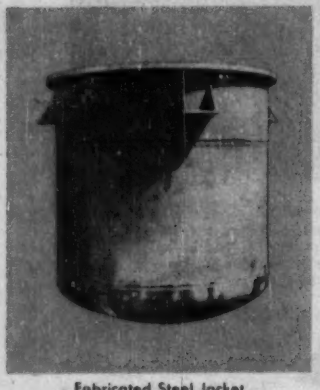
1500 Gal. Cast Reaction Vessel



72" Dia. Cast Cover



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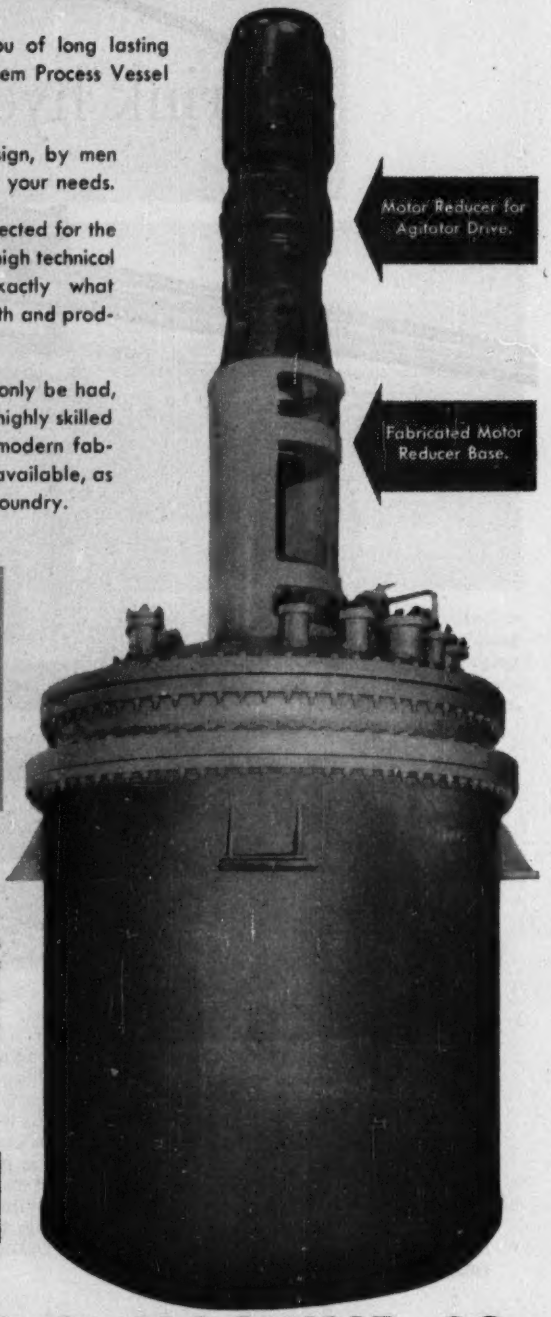
These factors assure you of long lasting satisfaction from any Bethlehem Process Vessel you install in your plant.

- A good, functional design, by men who know how to meet your needs.
- Materials especially selected for the job, by metallurgists of high technical ability, who know exactly what metals to use for strength and product requirements.
- Workmanship that can only be had, when experienced and highly skilled workers and complete modern fabrication equipment are available, as they are at Bethlehem Foundry.

Here are shown the component parts of one of Bethlehem's Reaction Kettles — typical of countless process vessels produced in our thoroughly equipped plant at Bethlehem, Pennsylvania.

For details regarding Bethlehem Kettles write us today.



BETHLEHEM FOUNDRY & MACHINE CO.

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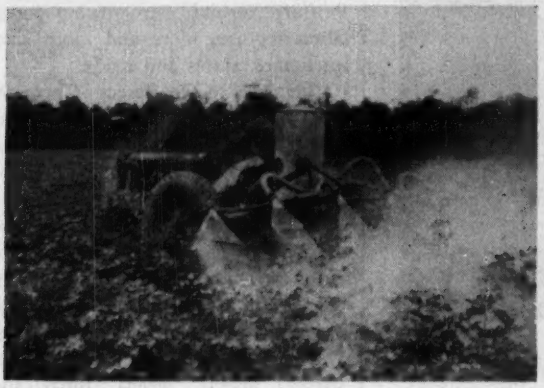
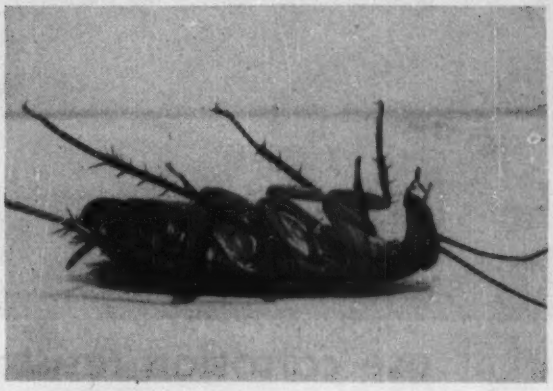


HERBICIDES



INSECTICIDES

DEFOLIANTS

SOIL CONDITIONERS

Feast or Famine—Ag Chemicals Hold Key

Burgeoning population, steadily decreasing farm acreage dictate more extensive and better use of chemical crop improvers.

Chemical agriculture—the science of soil fertility and plant protection—is the nation's best hope for more efficient utilization of existing farm resources. And increased efficiency is crucial if living standards are to advance, for population is rising steadily, while useable acreage and the farm labor force are decreasing.

The U. S. population is increasing by 2.6 million a year. Since every American, on the average, consumes 1,600 pounds of food a year, our annual food production in 1960 must be 15 million tons above present levels just to care for individuals as yet unborn.

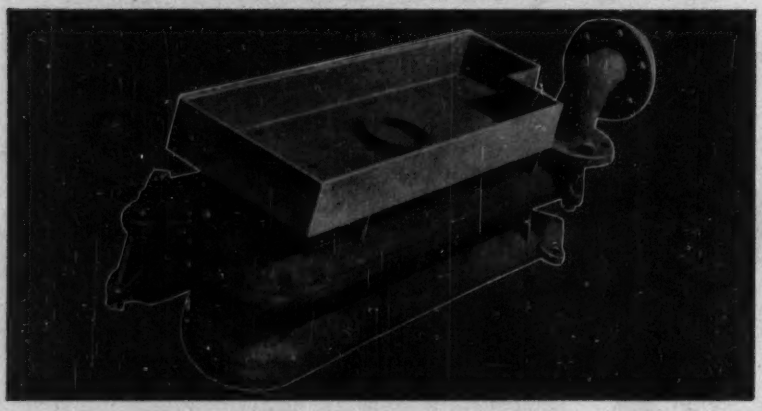
▶ **Relentless Pressure**—Previous population increases have been met by rising farm output. But the developments that led to increased agricultural output are in the leveling-off stage and are not likely to be of much future help.

Consider the period from 1930 to 1950. Population rose by 28 million. But at the same time three revolutionary developments in agriculture helped increase farm output.

- We killed off horses. The horse population in 1930 was 25 million. The animals worked hard but ate heavily, consuming a substantial portion of the total output of oats, corn and pasture. Now tractors have taken over and there are only 5 million horses. Land once used to grow food for 20 million horses now produces food for human consumption.
- The development of hybrid corn has contributed much to greater yields per acre. In 1930 corn plantings yielded 21 bushels to the acre. Today the yield is nearly 40 bushels from the same land.
- Soy beans are grown in areas no longer devoted to corn. This provides a better balanced ration for the nation's livestock. The doubling of the number of pounds of milk per cow since 1930 reflects this better feed.

But the impetus provided by these three factors has about worn off. In addition, we cannot expect to increase

FOR EASIER MAINTENANCE . . .



use corrosion resistant, easy-to-clean

NATIONAL (CAST IRON) DISTRIBUTING PANS

on NATIONAL COOLING and CONDENSING SECTIONS

Where cooling water is apt to contain trash, mud, shellfish or other foreign matter, NATIONAL Cast Iron Distributing Pans provide many advantages for more efficient water distribution over cooling and condensing sections.

EASY TO INSTALL—One pan fits on top of each stack of sections. Simple downcomer pipe for feed—minimum number of connections.

SIMPLE TO MAINTAIN—If trash or mud gets into the pan, flushing or scooping the foreign matter out is easily accomplished with the open top pans.

CONSTANT WATER SUPPLY—The large orifices are sized and arranged to handle the maximum water capacity possible for efficient cooling with a moderate depth of water in the pan. Water quantity can be controlled by maintaining a pre-determined level in the pan, and flow conditions can be checked visibly.

LESS FOG OR MIST—The pan orifices drop water in solid streams to the topmost sections without spray or dispersion. This is an important feature when installation is near buildings or equipment subject to corrosion.

Send the coupon for complete details on National Cast Iron Distributing Pans.

Heat Transfer Division

NRC THE NATIONAL RADIATOR COMPANY
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The National Radiator Co., Heat Transfer Division, Johnstown, Pa.

☐ Please send me complete information on National Cast Iron Distributing Pans.

☐ Please send me a copy of Marvel HT-20 on National Condensing and Cooling Sections.

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ECONOMICS, cont . . .

our agricultural production by increasing the supply of crop land. We have reached our frontiers; no virgin territory remains; our growing population requires more and more land for homes, stores and roads.

▶ **Chemicals to the Rescue**—Chemical agriculture offers the best prospect as the nation strives to boost food production. And the possibilities of growth in the field are considerable.

Only one-fourth of the more than one billion acres of crop land is presently treated with fertilizer, less than one-eighth with pesticides. According to an article by Clyde Williams, Director of the Battelle Memorial Institute, insects, weeds, fungi and other agricultural pests cause annual damage estimated at $13 billion.*

Recent progress in chemical agriculture, however, has been encouraging. Nearly 95 million lb. of DDT were sold last year, twice as much as in 1946. Benzene hexachloride (BHC) has come into its own as a boll weevil killer, with 1952 sales of 65 million lb.

And other chemicals are being developed, too. Methoxychlor, less toxic to warm-blooded animals than DDT, is rapidly gaining favor. New chlorinated compounds are being used to rid farms of insects which have built up a strong resistance to DDT. A new type of systemic insecticide that penetrates the plant system and provides inner protection against the ravages of certain insects has recently become available.

▶ **Soil Conditioners**—Within the past two years nearly two dozen soil conditioners have been put on the market. While sales to date are not exactly astounding—less than 1.5 million lb. last year—research is continuing. And most companies are optimistic about the future outlook.

Plant growth regulators of many types are also in the limelight. These new chemical products are being used to prevent fruit drop before harvest and to control undesirable growth during storage or shipment. One product, known as DCAA, slows the growth of the main stem of tomato plants. In other plants it inhibits the growth of ornamental parts without injury to the edible portions.

Monthly Business Review, Federal Reserve Bank of Cleveland, July 1953.

Defoliant chemicals for cotton are being used in increasing quantities, too. Mechanical cotton picking can only be practiced if defoliants are used to make the plants drop their leaves before picking time. These chemicals also permit hand picking to be speeded up by 100 percent.

And at least two chemicals—2,4-D and 2,4,5-T—are being used successfully for the destruction of mesquite. Heretofore, this deep-rooted shrub that kills vegetation on grazing lands had resisted the onslaughts of everything from fires to bulldozers.

▶ **Much Work to be Done**—Despite the encouraging results of recent research in chemical agriculture, many problems remain. Chemicals are needed which will enable plants to absorb considerably more of the sun's energy than the present 4 percent. Agricultural experts are counting on the chemical industry to turn up a product that will regulate the loss of moisture from foliage and thereby reduce damages arising from drought.

Chemical agriculture, in many cases, has succeeded in increasing bulk yields. The next step must be to improve the nutritional value of a wide variety of farm products.

We've come a long way indeed in the past 20 years. The production of farm chemicals—exclusive of fertilizers—has risen from 50 thousand tons to over 600 thousand tons annually. Synthetic organics account for over a third of this total with sales amounting to about $150 million. And fertilizer consumption has risen from 5 million tons to 22 million tons.

For chemical firms the growth and expansion of chemical agriculture spells a large and growing market for a multitude of products. For the nation, chemical agriculture is a key to a more abundant and better diet.

Defense Expansion Nears Completion

Latest Office of Defense Mobilization figures reveal that our defense expansion program is rushing to completion. Of a total of $25.8 billion in issued certificates of necessity, 1950 through March 1953, $18.2 billion worth—71 percent—will be completed by the end of this year.

And although more certificates are issued every month—$2.3 billion since March—the rate is rapidly tapering off.

The extent to which metal will corrode in atmosphere — or even whether it will corrode at all to any appreciable degree — is determined primarily by the moisture content of air. While deterioration at normal temperatures and humidities of less than 35% is so slow as to be almost negligible, the rate accelerates rapidly beyond a critical point of approximately 65%. This activity is intensified when such contaminants as hydrogen sulfide or sulfur dioxide are absorbed from industrial atmospheres. Impingement of solids, which tends to hold this acid film in contact with metal, localizes and further advances corrosive attack.

When exposure to atmosphere includes also exposure to sunlight and to the variables of weather, the situation becomes more complex. Such factors as the composition of metal and of the protective rust film that forms upon it, the length of time surfaces are wet, the extent to which they retain moisture, and whether they may be bared intermittently by heavy rainfall are influential in determining metal life.

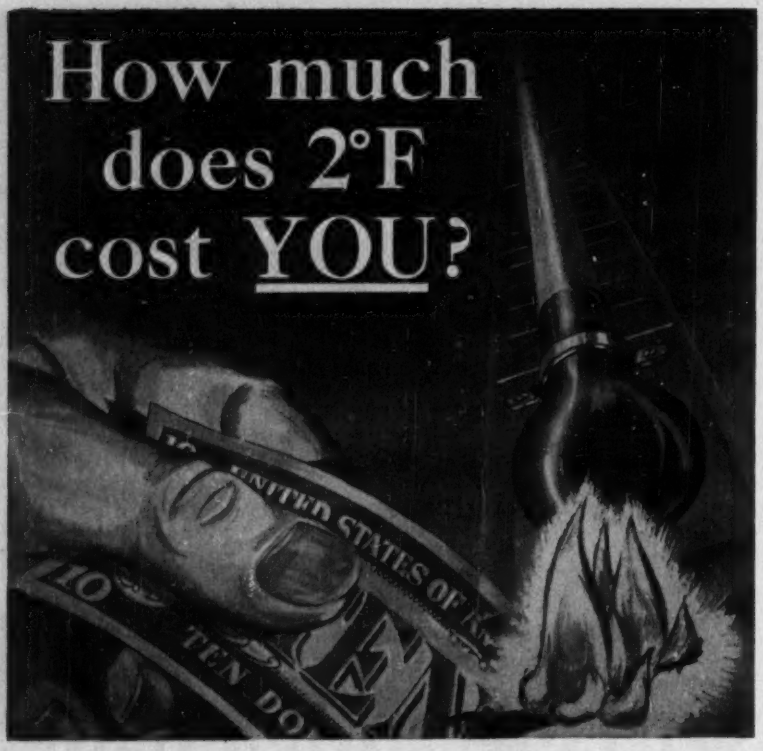
An understanding of the mechanism of corrosion in all of its varied phases is an obvious requisite to prescribing methods of control. Thirty-five years' study and evaluation of industrial corrosion problems and the formulation of protective coatings to meet them has taught us something about corrosion and the ways in which it may be checked successfully.

We are ready to share that knowledge with you in an analysis of any metal-maintenance problem you feel requires the *different* approach of considered engineering judgment . . . to give you a recommendation you can be sure is technically correct and practically workable — for quality protective surfacing that is right for you because it is individually job-selected to meet your service specifications.

MAINTENANCE FOR METAL

THE DAMPNEY COMPANY

160-1 HYDE PARK, BOSTON 36, MASSACHUSETTS



QUESTION — A manufacturing process is powered by a 8000 K. W. turbine. For the most economical operation, water used in the process should be cooled from 105° F to 85° F, at 77° F wet bulb temperature. How much will this cooling tower cost?

ANSWER — A tower with a .78 water-air ratio is needed and will cost about $50,000.

QUESTION — How much can be saved if the tower cools from 107° F to 87° F at 77° F wet bulb temperature — 2° F higher temperature?

ANSWER — This tower will require a .95 water-air ratio, and will cost only .78/.95 x $50,000, or $41,000, a saving of $9000 in initial cost.

QUESTION — Then, isn't the second tower the better buy?

ANSWER — Before answering, let's examine your operating cost. The steam needed to operate a 8000 K. W. turbine costs about $750 per day. The 2° F overage on the second tower will increase your fuel consumption 3%, so your operating cost will be increased $22.50 per day, or $6750 per 300 day year. In ten years, your operating cost will be increased $67,500, or more than the initial cost of the first tower. The answer is definitely, No!

When considering a new cooling tower, get the best engineering advice possible — consult a WCEC engineer. And after your tower is built, installed, and in operation, be sure that it meets your specifications.

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Very few additions are expected next year.

According to ODM, completions of defense projects will also take a big drop in 1954—$5.5 billion as compared to $12.5 billion this year. In 1955 the schedule calls for completions valued at $1.2 billion, leaving less than $1 billion to be spent in 1956-1960.

A glance at the following table indicates some lagging in the chemical process industries. But analysis of this year's industrial spending, including non-certificate-of-necessity spending, shows that the chemical group is actually going stronger than ever. Top spender in 1953 will again be the petroleum and coal products industry—$2.8 billion. In second place is chemicals and allied products which will lay out $1.8 billion—24 percent more than last year.

Progress in Defense Expansion

	Total Cost[1] Millions	Percent Finished[2]
Chemicals, Allied Products		
Inorganic chemicals	$870	55.6
Organic chemicals..	636	60.8
Alkalis & chlorine..	314	82.1
Plastics	274	44.5
Synthetic fibers....	252	75.2
Comp. & liquefied gases	128	81.1
Other	552	63.8
Total	3,026	62.6
Petroleum, Coal Products		
Petroleum[3]	1,615	50.5
By-product coke ovens	220	58.5
Other	98	40.8
Total	1,933	50.9
All Manufacturing ...	14,400	67.5
All Industry.....	$25,788	67.3

[1] Based on certificates of necessity issued from 1950 through March 1953.
[2] Based on estimated completion through June 1953.
[3] Petroleum refining only.

Chemical Industry Looks Forward to 1954–1955

According to a recent McGraw-Hill survey of U. S. chemical producers and consumers, the next few months will show the start of a long-range upswing for many products. Demand will grow, supplies will be plentiful for most products.

But some buyer resistance to high prices will be felt soon. Production of many chemicals is already ahead of consumption. This means increased competition and more determined selling.

Because of oversupply, prices will go down in oils, pesticides, glycols, ethyl alcohol, hydrochloric acid and caustic. Present rates will be maintained in toluol, polyethylene, some

phosphates, ammonia and phthalic anhydride.

▶ **Pesticides**–Business is exceptionally poor. Light weevil infestation in the cotton crop last summer left makers of benzene hexachloride and DDT with large stocks. And sales are expected to be even worse in 1954 because of lower farm income.

▶ **Sulfur**–Demand remains at a good level–about the same as last year. Supply is in balance and price should continue at about $70/ton.

▶ **Gum and Wood Rosins**–Large stocks are gradually being moved. Domestic requirements have picked up some in the fourth quarter. France and Portugal, normally heavy suppliers, report decreased output. This means more business for U. S.

▶ **Stearic Acid**–Sales are good, supplies plentiful and advance orders are brisk. Producers expect recent price rise to be maintained indefinitely. Retail sales of cosmetics and soaps–biggest market for stearic–are expanding and should reach $1 billion this year.

▶ **Acrylonitrile**–Consumption is slackening. Textile men grumble about dyeing difficulties and high price–36c. per pound.

▶ **Pharmaceuticals**–Retail sales fell this year, but total will be close to $1 billion. The industry is disturbed by higher production costs, decreased exports and severe competition. Drug makers will spend about $75 million for research in 1953. Goal is a broadening volume of new products, as well as more sales.

▶ **Leather-Processing Agents**–Manufacturers will buy about $8 million of heavy chemicals for making leather this year. Research efforts to find domestic raw materials for tanning have been intensified. In 1952 this nation imported nearly 80 percent of its tanning. The 1953 figure is expected to be higher.

Outlook is good in the leather market as shoe sales remain at peak levels. But synthetics are making some inroads. More than 6 million lb. of vinyl resins will go into handbags alone this year.

▶ **Vitamins**–Both output and consumption are growing, but there will be some price drops in 1954. Nearly 85 percent of bulk medicinal chemical sales last year consisted of vitamins, antibiotics and sulfa drugs.

▶ **Antibiotics**–Sales and production

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Company _____

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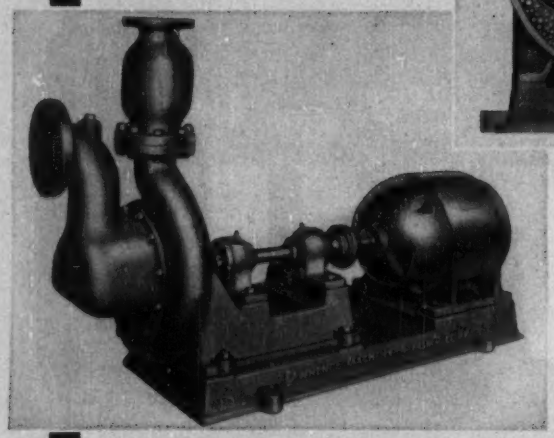
(Right) Lawrence Self-Priming Pump exhausting air during priming.



(Left) Lawrence Heavy Duty Self-Priming Chemical Pump.

LAWRENCE . . .
SELF-PRIMING PUMPS

Patent Applied For

A new type for many exacting services

The Lawrence self-priming pump introduces a new feature: — specifically, a pump that operates as a positive air pump during priming and then as a regular centrifugal pump. No valves of any kind are required. After priming, it operates — without recirculation of the liquid — at full efficiency.

Because dead spaces are eliminated and clearances are not close, the pump can be used for pumping liquids containing solids and abrasive matter in suspension. It can be furnished in all sizes for all classes of service: — water, slurry, sludge, acids and chemicals.

For further information and performance data, write for Bulletin 210-1.

LAWRENCE PUMPS INC.

371 MARKET STREET, LAWRENCE, MASS.

mount. Prices should drop generally next year due to oversupply, sharper competition and development of new "miracle drugs." But penicillin price is already at the bottom.

Brazil Must Import More Insecticides and Chemicals

Brazil needs $6 million (U. S.) of imported insecticides and chemical products. Half that amount must come from the United States, according to the Insecticides Industries Syndicate. This group has requested the Brazilian Export-Import Dept. to allow importation of insecticides without restrictions.

The syndicate has also drawn up a list of the insecticides and chemical products needed:

	Quantity, Tons	Value, Thousands
Benzene hexachloride	1,903	$747
DDT	400	215
Chlorate of camphene	926	430
Finely-divided sulfur	1,780	168
Methylbromate	229	643
Attapulgus clay	700	53
Fungicides	103	151
Herbicides	40	94
Copper sulfate	130	41
Metaldehyde	12	24
Miscible oils	140	106

Despite Some Pessimism, Economic Outlook Is Good

If you look at the normal business barometers—stock market decline, decrease in sales of scrap steel, shrinkage of the money supply, big inventories—it's easy to see why many top-flight economists are predicting rough seas for the current business boom.

Actually, says the U. S. Chamber of Commerce, there are a lot of favorable factors in our economy. Employment is at an all-time peak. So are sales and business income. The national income, too, is rising. During the last year national income went up $21.5 billion, of which employees got $18.5 billion. And next year there will be several tax cuts, including a 10 percent cut in personal income taxes. People are already planning how they're going to spend that extra 10 percent.

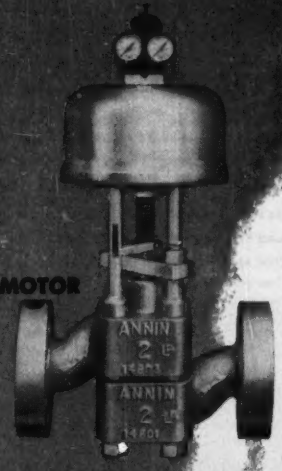
These good signs combined with the rapid development of such new products as color TV and room air-conditioners, and our phenomenal population increase mean many new markets, markets that certainly justify optimism both for next year and for the long run.

REACHING FOR NEW HIGHS

Annin's superiority comes from the rugged proving grounds of guided missile work, where simple valve design, rugged construction and dependable operation are the factors that count. From this beginning Annin research and engineering have constantly reached for "new highs" in efficient control of difficult fluids under extreme conditions of pressure and temperature. This experience can now be applied in solving YOUR high pressure problems with these new standard model Annin Domotor, Cylinder and Handwheel operated valves. Pressure and temperature ratings of 6000 psi (standard*) and —325° F to 1200° F. Like all Annin models they offer flexibility in operation, bubble-tight shut-off, reduction in valve inventory and low maintenance cost. Get the facts today on ANNIN's work in the high pressure field, and what this experience can mean to you in savings and service.

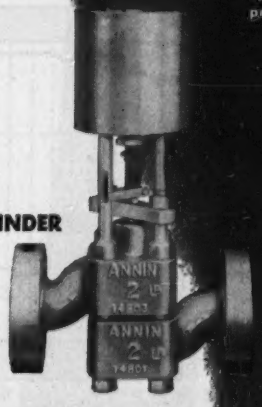
*Special valves now in production to 30,000 psi

DOMOTOR



Model 2560, series 90-150, pressures to 3600 psi; temperatures —325° F to 1200° F.
Model 3560, series 250, to 6000 psi.

CYLINDER



Model 2520, series 90-150, pressures to 3600 psi; temperatures —325° F to 1200° F.
Model 3560, series 250 to 6000 psi.

Model 25, series 90-150, pressures to 3600 psi; temperatures from —325° F to 1200° F.
Model 35, series 250, to 6000 psi.

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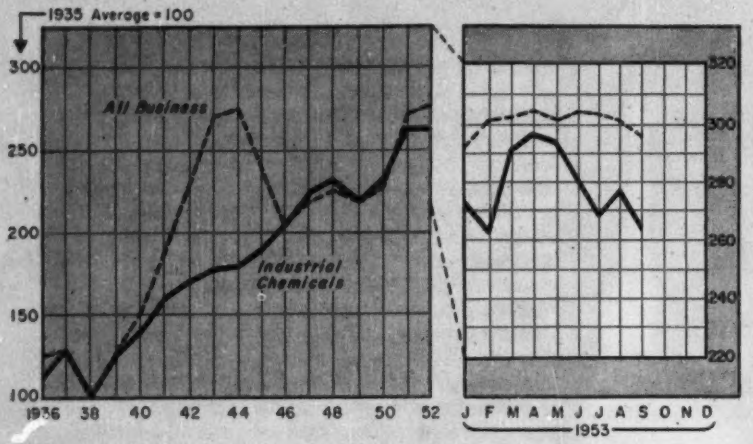
ANNIN Control VALVES

Process Industry Trends

Douglas Greenwald, McGraw-Hill Dept. of Economics

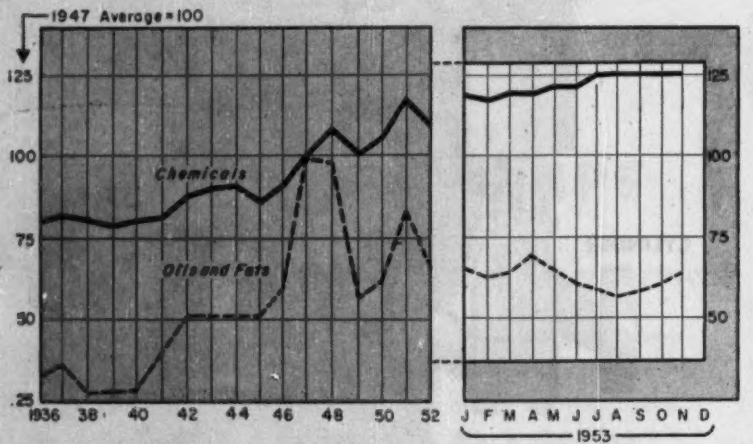
CONSUMPTION



Industrial Chemicals Index

	Sept. (Est.)	Aug. (Prelim.)	July (Revised)
INDEX	265.00	277.22	268.17
Fertilizer		53.60	50.53
Pulp & Paper	29.96	31.79	28.32
Petroleum Refining	27.44	28.76	28.63
Iron & Steel	16.35	17.25	17.01
Rayon	26.27	30.99	32.17
Glass		24.52	23.65
Paint & Varnish		29.27	29.99
Textiles		10.67	9.43
Coal Products		12.44	12.55
Leather	4.14	4.37	3.74
Explosives		9.81	8.80
Rubber	5.94	5.90	6.06
Plastics		17.85	17.29

PRICES

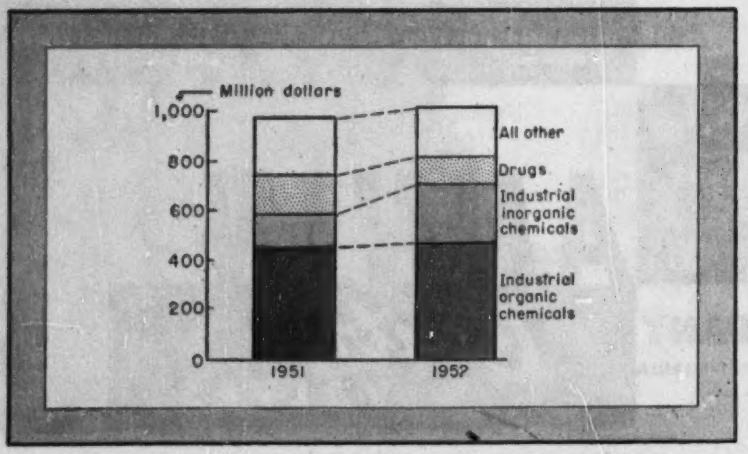


Chemical Engineering's Price Indexes

Chemicals	DOWN	−0.06%
Oils and Fats	UP	+4.6%

	Chemicals	Oils & Fats
As of November 1, 1953	125.08	63.78
Last Month October 1953	125.16	60.96
Year ago November 1952	119.06	60.98
Two years ago Nov., 1951	119.92	74.24

HIGHLIGHT OF THE MONTH



Recent Release Shows Capital Spending in '52

The Census Bureau has now released its '51-'52 breakdown of capital spending in the process industry.

1952's slight increase was mirrored by the industrial organics industry where 1952 expenditures were less than 4 percent over the '51 figure.

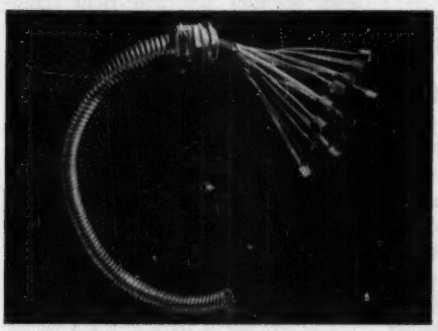
Industrial inorganics showed the biggest increase. Spending jumped 75 percent to $256 million in '52.

Paint, soap and drug firms wound up expansion in '51. Consequently, they spent 40 percent less in '52.

For the new pneumatic instrumentation

Cabled Tube

The recent tremendous increase in the use of tube instead of wires for instrumentation and control purposes has led to an important new development—cabled tube. This is an armored group of long tubes twisted together to permit bending without distortion. An insulating tape is wrapped over the bundle of tubes to prevent electrolytic action. Then interlocking, flexible galvanized steel armor is applied, like BX. This protects the tubes from injury during shipment, storage, installation, and in service. Standard fittings, boxes and cabinets can be used for junction boxes and terminations. To make it possible to readily identify each tube, one tube in each layer is colored; the position of each tube in each layer in relation to the coded tube

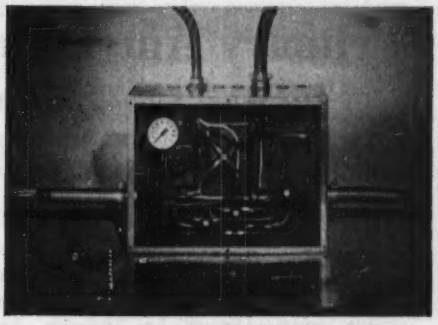


remains the same throughout the length of the cable.

The tubes usually are copper, but aluminum tubes can be used for special purposes. For unusually corrosive situations, a plastic outer sheath can be applied. As many as 19 tubes, ¼" OD, can be cabled, and supplied in lengths up to 1,000 ft.

Showing the construction of Crescent Armored Multitube, made by Crescent Insulated Wire and Cable Co., Trenton 5, N. J., which will supply further information on request.

Since the tubes carry not electricity but air, nitrogen, helium, or a fluid, they are especially attractive in potentially explosive locations, as in refineries and chemical plants. Utilities are also turning decisively to this new cable, while automatic process control (automation) is a rising application.



Revere, as a supplier of tube for this purpose, calls this cabled tube development to your attention as a matter of general and perhaps specific interest. See Revere for copper, aluminum and brass tube and pipe, electric welded steel tube, and lockseam tube. Call the nearest Sales Office.

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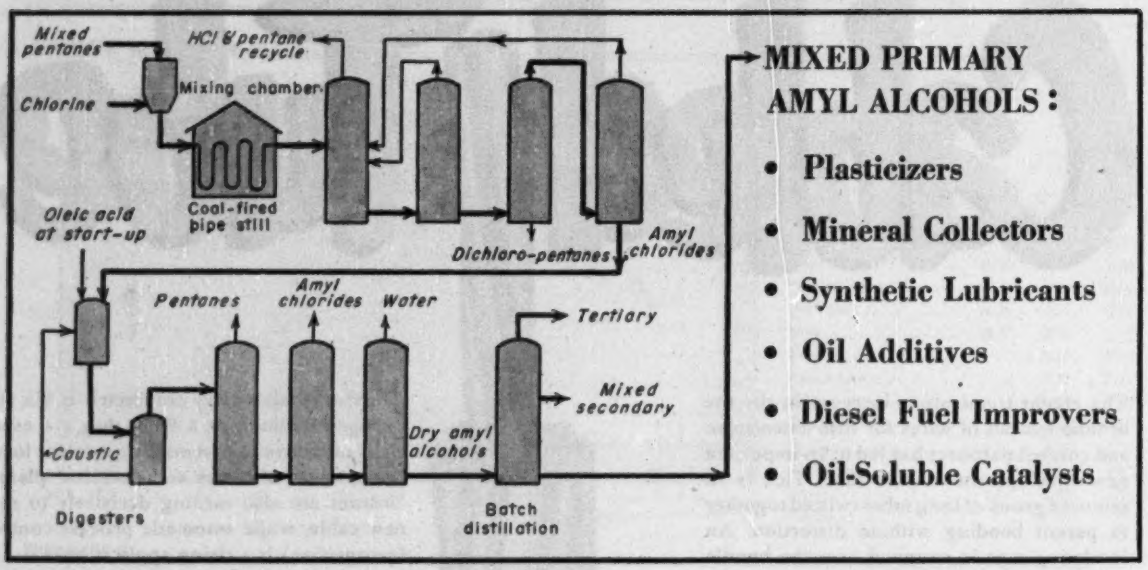


Primary Amyl Alcohols—A New Building Block

Of prime interest to makers of plasticizers, oil additives and esters, these new alcohols have a very uniform composition and are readily available.

Now, for the first time, you can get synthetic amyl alcohols containing at least 95 percent primary isomers in continuing tank car quantities. This recent announcement by Sharples Chemicals Inc., a subsidiary of Pennsalt, should be welcome news to many segments of the chemical industry.

Biggest potential use is as a replacement for butyl alcohols in the manufacture of plasticizers. More than half the total plasticizers sold in this country are of the alkyl phthalate type—over 106 million pounds in 1952—and Sharples thinks that primary amyl alcohols will be able to take over a big share of the 12.5 million-lb. dibutyl phthalate portion of the market and thus regain their prewar significance.

▶ **War Shortage**—Until about 1942, amyl alcohols were used extensively in the production of esters, particularly for diamyl phthalate which was a preferred plasticizer for lacquers. But during World War II, because of government allocations, amyls became practically unobtainable and plasticizer manufacturers switched to butyl alcohol as a raw material.

Amyl alcohols reappeared after the war via two processes, the Ayres synthetic method used by Sharples—chlorination of mixed pentanes followed by hydrolysis—and fermentation of fusel oil. A third method, the Oxo process, is now being pilot-plant tested for amyl alcohol production by several major companies.

▶ **Seven Isomers**—Before the advent of the synthetic mixed primaries Sharples' output was mostly mixtures of the seven practical isomers of amyl alcohol, plus some straight tertiaries and mixed secondaries. The 7-isomer mixtures are fine as solvents and in reactions where the type of isomer present is not too important, but they aren't acceptable in the many markets requiring specific isomers or groups of isomers. In any esterification, for example, the excellent reactivity of primaries makes them much superior to secondaries.

Sharples found that the amount of primary isomers formed can be increased by increasing the ratio of iso- to normal pentanes in the chlorination unit feed. And equally important, separation of the three isomer groups—primary from secondary from tertiary—becomes easier.

The company's mixed primary amyl alcohols are guaranteed to be at least 95 percent primary, very important from reaction rate and yield standpoints. And the price structure promises to be stable, too. Amyl alcohols from fusel oil, while mostly primary, vary considerably in composition and price due to severe fluctuations in raw materials.

▶ **Amyl vs. Butyl**—The major hurdle for primary amyl alcohols in their race with butyls is price. Primary butyl alcohol is currently selling at about 13c./lb., primary amyl, 5-6c. higher.

But the amyls have two big advantages: lower vapor pressure and greater oil and hydrocarbon solubility. In plasticizers, for instance, the amyl compounds have much greater solubility for hydrocarbon-soluble resins in the lacquer film.

Oil additives, too, are important potential users of these new alcohols. Several families of additives call for alkyl alcohols in their production—dialkyl dithio phosphates, for example—and the high degree of oil solubility that primary amyls will impart to them should make the amyl alcohols

competitive with butyls despite the price differential.

▶ **Mineral Collectors**—Another important field for alcohols is in the manufacture of alkyl xanthates as collectors in the concentration of minerals. These compounds function by promoting contact between the mineral particles and air, forming a thin coating over the selected minerals and thus rendering them water repellent. Primary alcohols are much preferred for making amyl xanthates because of their ease of reaction.

Following closely behind the xanthates are applications in oil-soluble catalysts for resinification—alkyl phosphites and phosphates—where the presence of amyl groups confers high oil solubility to the catalysts.

Rounding out the use pattern for the alcohols is the broad range of alkyl esters and salts needed by the chemical industry. Amyl adipates and sebacates are getting close scrutiny for use as synthetic lubricants and plasticizers, and at least one amyl salt has shown great promise as an additive for diesel fuel improvement.

As an adjunct to its primary amyls, Sharples is also marketing the secondary and tertiary isomers, as well as mixtures of the three types. The secondaries can be used to make certain ester and to produce ketone-type solvents. The tertiary alcohol, lowest-boiling and most water-soluble of the three, dehydrates easily to alkylating agents and is also used in selective solvent processes.

•

Metallic Coating

For thermosetting plastics is first of pigmented type not to gel on standing.

Here's a new pigmented metallic coating for phenolic, polyester, urea and melamine plastics. Called Logoquant P-6, the finish is the first of its kind that will not gel on standing. And tests at 100 deg. F. and 100 percent relative humidity show no softening or loss of adhesion after 800 hours.

Best results in using the finish are obtained with a 10-minute bake at 250 deg. F., as compared to the standard 40-minute bake at 300 deg. F. for other coatings for thermosetting plastics. If desired, a quality finish sufficient for most needs can be achieved by air drying at temperatures below 250 deg. F. This should be a big help in making plastic parts that tend to warp at higher temperatures.

The coatings will be used on a full range of plastic parts, including phenolic radio and TV cabinets, vacuum cleaners and cabinets.—*Logo, Inc. (subsidiary of Bee Chemical Co.), 13799 South Ave. O, Chicago 33, Ill.*

IN BRIEF—A capsulated listing of this month's newsworthy products.

It's New . . .	It's Good for . . .	See Page . . .
Primary Amyl Alcohols	Making plasticizers, oil additives and esters	332
Metallic Coating	Thermosetting plastics; doesn't gel on standing	333
Foamed Silicone Resins	Use as lightweight, nonflammable structures	333
New Antibiotic	A broad spectrum of ailments	334
Fertilizer	General crops; has high nitrogen content	334
Inhibitor	Packaging quaternary ammonium compounds in metal	334
Sodium Polyphosphate	Oil well drilling muds and detergents	334
Underground Insulator	Giving permanent protection to hot pipes	334
High-Tenacity Rayon	Tire cords, textiles and reinforcing plastics	336
Alkyd Coating Resin	Lowering costs of coatings without quality loss	338
Desiccant	Removing water and acid from refrigeration systems	338
Metal-Plastic Laminate	Combining strength of metal with protection of plastic	340
Mold Release	Use on porous surfaces	342
Polymethoxy Acetals	Plasticizers, solvents and resin modifiers	342
Beryllium Flakes	Hot press fabrication of beryllium	342
Vinyl Base Cement	Protecting against acids, benzene and chlorine dioxide	342
Molybdenum Disilicide	Heating elements for making glass and ceramics	343
Cleaner-Inhibitor	Cleaning and protecting iron and steel tanks	343
Alkyl Phenols	Removing plant foliage	343
Fire Extinguisher	Many types of fires; more effective than CCl_4	343

Foamed Silicone Resins

For use as lightweight, nonflammable structures.

These two new silicone resins, XR-543 and XR-544, can be blown and expanded to form uniform, closed cell structures weighing as little as 8 lb./cu ft. Such foams have been exposed to temperatures above 700 deg. F. for 20 hours with very little structural change. Panels over ½-in. thick can be brought to red heat over an open flame without significant decomposition.

The expanding of these resins is accomplished by melting them, dispersing a blowing agent and catalyst in the molten mass, expanding with air and curing at 250 deg. C. Upon curing both products can be carved or cut with conventional tools.

XR-543, while it has good compressive strength at low temperatures, becomes thermoplastic above 500 deg. F. with no change in appearance. For this reason it's suggested for use in applications such as vibration damping, electrical, acoustical and thermal insulation and buoyancy units.

XR-544 does not lose compressive strength, though, and can be used wherever both high strength at elevated temperatures and good heat stability are needed, such as in fire walls.—*Dow Corning Corp., Midland, Mich.*

Antibiotic News

Three companies make tetracycline by two processes; two firms introduce stable liquid penicillin suspension.

Working independently, American Cyanamid's Lederle Laboratories, Pearl River, N. Y., and Chas. Pfizer & Co., Brooklyn, have isolated a new, broad-spectrum antibiotic called tetracycline. Both use a process which replaces the chlorine in chlorotetracycline (Lederle's Aureomycin) with hydrogen, using a palladium catalyst. Indications are that oxytetracycline (Pfizer's Terramycin) is also a possible raw material for a similar process, but so far, Aureomycin is considered more economic.

Almost simultaneously, Heyden Chemical, New York, announced that they can make the drug by a fermentation process, rumored to be much cheaper. Following this, Heyden completed an agreement to sell its antibiotic processes and patents to Cyanamid. If tetracycline is included, Lederle should have a big market jump over Pfizer.

Antibiotic experts definitely feel that tetracycline is the hottest newcomer in a long time. Its test-tube activity parallels that of both Terramycin and Aureomycin and, more important it has fewer and much less severe side effects.

• Bio-Ramo Drug Co., Baltimore, Md., with its new K-Cillin, and Bristol Laboratories, Inc., Syracuse, N. Y.,

with Clilloral Suspension, have simultaneously achieved a stable liquid suspension of the soluble salts of penicillin. Both products have shelf lives of at least 2-3 years without refrigeration. Earlier attempts to reach this goal resulted in products that retained full therapeutic potency for only a week.

Fertilizer

Contains four times as much nitrogen as conventional products and uses no filler.

Arcadian 12-12-12, a new, high-analysis general crop fertilizer, may well help farmers cut their production costs. And at the same time, because nitric acid is substituted for sulfuric in part of its manufacture, an annual saving of 88,000 tons of 100-percent sulfuric acid is forecast.

Since each granule of the product contains a minimum of 12 percent each of nitrogen (four times as much as conventional 3-12-12 fertilizers), available phosphoric acid and potash, farmers will be able to make one application where they used to need two of a lower analysis fertilizer. And with half the nitrogen present as ammonia and half as nitrate, benefits will be both quick-acting and long-lasting.

According to the manufacturer, the 12-12-12 analysis is in line with the 1-1-1 plant food ratio advocated by most agronomists. Production of the material will come from the company's new $5 million plant in South Point, Ohio.—*Nitrogen Div., Allied Chemical & Dye Corp., New York 6, N. Y.*

Inhibitor

Permits packaging of quaternary ammonium compounds in metal containers for the first time.

Use of a new inhibitor called QAI (2-hydroxypropylamine nitrite) will, for the first time, allow you to put products containing quaternary ammonium compounds into all-metal containers.

According to the manufacturer, only 0.05-0.5 per cent of QAI is required to inhibit the corrosive properties of these compounds, widely used in the manufacture of cationic disinfectants. Tests show that metal containers containing products with as much as 10 percent quaternary ammonium compound inhibited with QAI show no signs of corrosion after three years of storage.

And the inhibitor, which is completely soluble in water base materials, is reported to be equally effective in liquid soaps, phenolic and pine disinfectants, emulsion floor waxes and other water base compounds with pH's above 8.0. This means that manufacturers of disinfectants and other corrosive materials normally packaged in glass will be able to reduce packaging, shipping and breakage costs.—*R. M. Hollingshead Corp., Camden, N. J.*

Sodium Polyphosphate

Has lower pH and higher P_2O_5 content than predecessors.

Metafos, a new condensed sodium polyphosphate, is now available from Rumford Chemical. The new product is similar to the company's Quadrafos, but has a higher percentage of P_2O_5—67 percent vs. 63.5 percent—and a lower pH in solution. There is no price differential between the two.

Biggest tonnage use of Rumford's polyphosphates is as a viscosity controller for oil well drilling muds. Allowable alkalinity limits for this operation are very narrow and it's expected that drillers will be able to use Quadrafos until the upper limit is reached, then switch to Metafos until the lower limit is approached.

Nearly as important as the above is the use of phosphates in detergents for the bottle cleaning, metal cleaning and textile industries. In boiler cleaning it's important that the P_2O_5 content be as high as possible in order to combine with a maximum amount of calcium. In certain textile printing operations that use hydrogen peroxide, a low-alkalinity phosphate is essential. Metafos fits both bills nicely.—*Rumford Chemical Works, Rumford 16, R. I.*

Underground Insulator

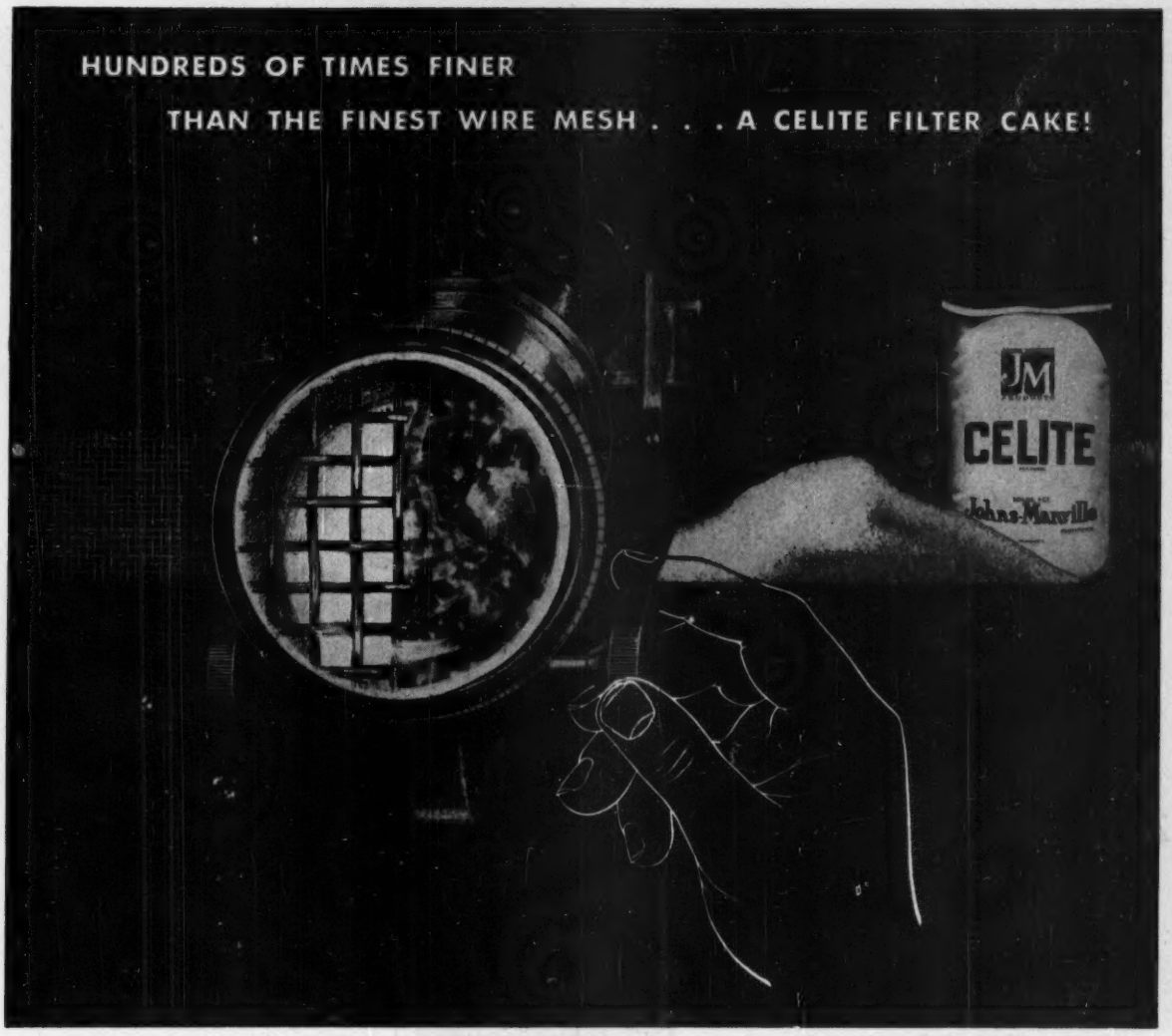
Provides permanent, triple-zone corrosion protection for hot pipe installations.

A new, easy-to-install insulating material for hot underground pipes is now being marketed by American Gilsonite. Known as Gilsulate, it's a blend of specially sized and selected gilsonite, a highly resinous asphaltite found in eastern Utah and used for years in floor tile, paint and battery boxes.

Said to assure permanent protection against alkaline ground waters, electrolysis, root attacks and bacterial attack, Gilsulate forms three protective layers. When poured on a hot pipe, one layer melts and is fused to the pipe. The second layer is composed of sintered particles and the third of unconsolidated material.

The first two zones are waterproof, provide thermal and electrical insulation and allow the pipe to expand and contract easily. The unconsolidated layer gives additional thermal insulation and a high load-carrying capacity. Installation is accomplished by pouring the material around the pipe, tamping, backfilling and running a hot fluid through the pipe.

In contrast to present practices,



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Celite powders may be used with any type of conventional filter. Only 2 simple steps are required. First, a "pre-coat" of Celite is deposited on the filter medium. Second, small amounts of Celite are added to the solution, to form a continuously fresh filter surface. To meet different filtration requirements, Celite is available in nine standard grades of microscopically controlled particle size. Utmost uniformity is assured by exclusive processing techniques.

The extraordinary efficiency and flexibility of Celite Filtration have made it the standard for entire industries. For perfect clarity in food products such as jellies, sugar, wine, beer . . . for highest purity in antibiotics . . . for removal of impurities from chemicals, petroleum, dry cleaning solvents . . . Celite offers unequalled advantages.

If you want to improve your present filtration system or find an economical way to utilize filtration in your processing, investigate the Celite method now. One of the Johns-Manville Celite Filtration Engineers will gladly discuss your problem. These men are backed by complete technical services and the Johns-Manville Research Center, largest laboratory of its kind in the world. For further information write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

*Celite is Johns-Manville's registered Trade Mark for its diatomaceous silica products.

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electrical equipment.

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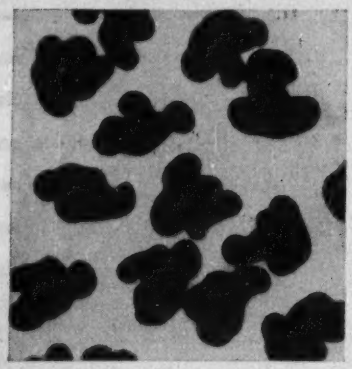
Gilsulate does not require sleeves to protect the insulation. And tests by Southwest Research Institute show that heat loss from the insulated pipe is 8-11 percent of the loss from a bare, buried pipe.

The product is available in three grades, each effective over a different temperature range and having different initial melting points at which the plastic zone is formed.—*American Gilsonite Co., Salt Lake City, Utah.*



High-Tenacity Rayon

Gives increased strength to tire cord and textile fabrics.

Rayocord-X, Rayonier's new high-tenacity rayon yarn, looks like the first competitor for Du Pont's Super Cordura (see *Chemical Engineering*, Sept. 1953, p. 390). Both products have highly-oriented, "all-skin" filaments (see cut) which impart toughness, high strength and excellent shock resistance to the yarn. And both will find their first use in tires.

There is a difference, though. Rayocord is made exclusively from chemical cellulose via the sulfite process; its filaments are produced in high-stretch spinning equipment which stretches them more than 100 percent. The Du Pont product, on the other hand, is made from a blend of wood cellulose and cotton linters. According to Rayonier, its fiber is a complete and more economical replacement of this type of cellulosic blend.

And Rayonier is looking beyond the tire cord market. The company feels that its product will have a big impact in rayon fabrics. It also expects a sizable market to develop for a reinforcing agent for plastics.

Rayocord's high strength — 4g./denier vs. 2g./denier for conventional rayon yarn—and its lowered tendency

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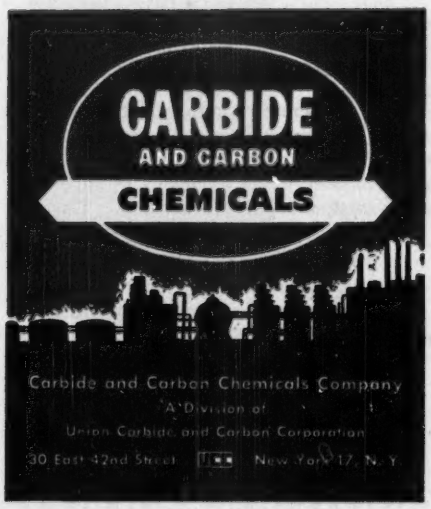
- First commercial continuous-process plant producing chemicals directly from coal.
- Plant makes phenols, anilines, aromatic hydrocarbons, heterocyclic amines.
- Over 100 chemicals identified in product streams.
- Now available commercially—mixtures of reactive, *meta*-substituted monohydric phenols *in tank-car quantities:*



META-PHENOLS 220

Boiling range 207-230°C. A mixture of cresols, xylenols, and ethyl phenols—2.2 *ortho* and *para* positions per molecule are open. Phenol and 2,6-xylenol are absent. Phenolic content—about 98%.

HIGH BOILING PHENOLS

Boiling range 230-270°C. A mixture of short-chain alkyl-substituted phenols—2.5 of three reactive *ortho* and *para* positions are open. Phenol and cresols are absent. Contains about 30% indanols-4 and -5. Phenolic content—about 98%.

Call or Write the nearest Carbide and Carbon office for samples and prices. In Canada: Carbide and Carbon Chemicals Limited, Toronto.

Ask for the technical bulletins on Meta-Phenols 220 (Form 8107), and High Boiling Phenols (Form 8103).

More coal-hydrogenation chemicals will be available soon—watch for them.

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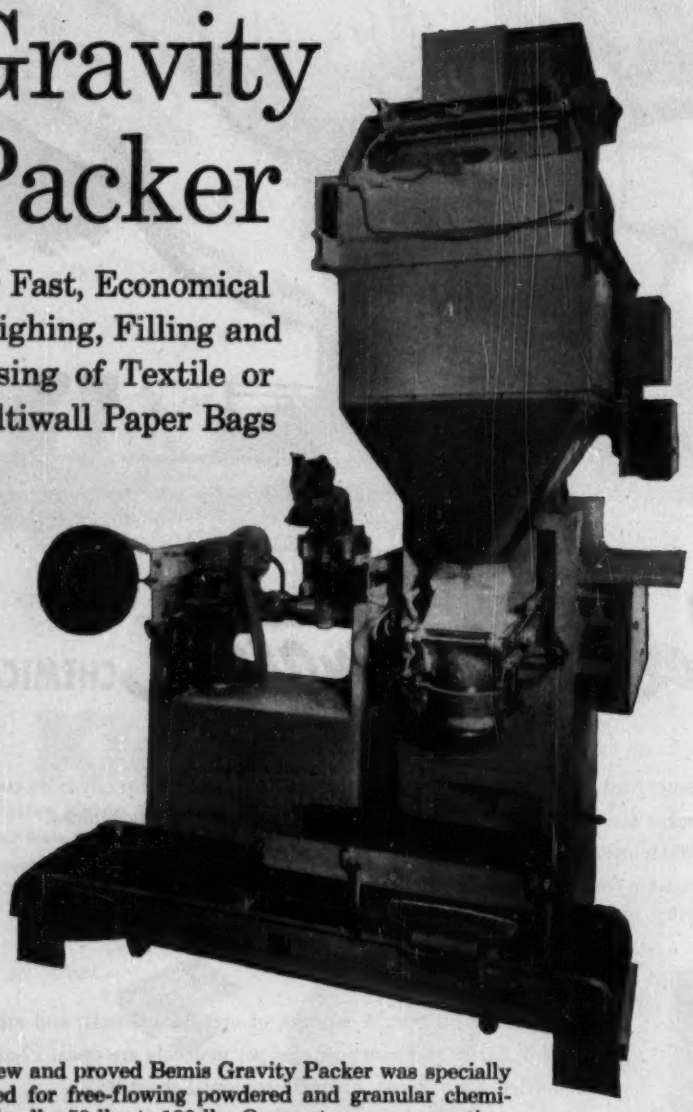

This new and proved Bemis Gravity Packer was specially designed for free-flowing powdered and granular chemicals. Handles 50-lbs. to 100-lbs. One- or two-man operation. Speeds—up to twelve bags per minute are normal. Actual production records of many concerns show a much higher out-put on this machinery. Ask your Bemis Man for the complete story.

Bemis

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to swell when wet give better wearability to any rayon fabric and allow the use of ordinary washing procedures. These factors, says the company, should substantially boost the use of rayon textiles from the present ratio of 8 lb. of rayon for every 23 lb. of cotton.—*Rayonier, Inc., New York 17, N. Y.*

Alkyd Coating Resin

Lowers cost of enamels and lacquers with no quality sacrifice.

A new alkyd coating resin with an important price advantage is now being marketed by Rohm & Haas. Called Duraplex ND-79, its properties are essentially the same as those of the company's standard nonoxidizing alkyd, Duraplex ND-78. Its price, however, is 1c./lb. lower—26.5c.

While this difference seems small at first glance, the keenly competitive alkyd market makes it very important. As one company official puts it, such a differential can easily mean the difference between success and failure of an alkyd resin.

ND-79 is a nonoxidizing resin with good color and color retention, high gloss and good resistance to alkalis. And it can be combined with urea, melamine and triazine resins to give tough enamel finishes.

All the standard uses for alkyds are envisioned for the new resin, including color-retentive baking enamels for appliances and durable nitro-cellulose lacquers for automotive and aircraft finishes. Xylol, toluol, esters and other common solvents can be used to reduce the resin—*Rohm & Haas Co., Philadelphia 5, Pa.*

Desiccant

Removes both water and acids from refrigeration systems.

Continuing its policy of supplying custom-built silica gels, Davison Chemical has introduced PA-400, a high efficiency refrigerant desiccant said to have twice the moisture adsorbing capacity of its predecessor, PA-100.

The presence of more than about 40 parts per million of moisture in a refrigerant is likely to cause freeze-ups, copper plating and corrosion of the system. PA-400 removes this water, drying Freon 12, for example,

Vulcanization Accelerators

In the manufacture of thiuram sulfide type of accelerators as well as dimethyldithiocarbamic acid metal salts.

Fungicides & Insecticides

In the manufacture of the zinc and iron salts of dimethyldithiocarbamic acid which is used in the form of its zinc and iron salts as agricultural fungicides.

In making the new systemic insecticides, such as octomethyl-pyrophosphoramide.

Fuel

Internal coolant to improve the performance of reciprocating engines.

Dyes, Drugs, Pharmaceuticals

In the synthesis of caffeine, aminophylline, theophylline, and vasoconstrictors.

In the manufacture of anti-malarials and long-chain quaternary ammonium compounds.

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CSC Monomethylamine CH_3NH_2, Dimethylamine $(CH_3)_2NH$ and Trimethylamine $(CH_3)_3N$ represent the most economical source of the amine group because of their low equivalent weights and moderate prices. Look how you can put these versatile amines to work for you.

Herbicides

As a neutralizing and solubilizing agent in preparation of concentrated solutions of 2,4-D salts and mixtures of 2,4-D with 2,4,5-T.

Catalysts & Accelerators

As catalysts where alkaline conditions are required for polymerization.

Textiles

To improve affinity of cellulose acetate rayon for direct cotton dyes.

In the manufacture of long-chain quaternary ammonium compounds for use as softeners, lubricants, and water-proofing agents.

Leather

For use in unhairing hides.

Surface-active agents

In the manufacture of amide and sulfonated amide-type detergents and surface-active agents.

Polymerization Inhibitor

Inhibits polymerization of unsaturated hydrocarbons during distillation.

Used as a stabilizer for certain types of resins.

Used to reduce webbing of natural and synthetic rubber latexes during dipping operations.

Other Uses

In the manufacture of photographic chemicals, the explosive tetryl, amide-type plasticizers, and ion-exchange resins. Useful as activators for paint and varnish removers based on chlorinated hydrocarbons.

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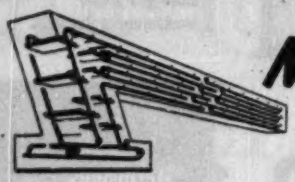

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to less than 10 ppm. at temperatures as high as 160 deg. F. The desiccant is also effective in removing hydrochloric and hydrofluoric acids formed by reaction of water and refrigerant.

To be sold in particles of 8-20 mesh, the new product is pre-attrited to minimize dusting. And having a density of 49 lb./cu. ft., it should be well-suited for inserting into systems in the form of small cartridges.—*Davison Chemical Corp., Baltimore 3, Md.*

Metal-Plastic Laminate

Combines structural strength of metal with corrosion resistance of vinyl plastic.

A new method of laminating vinyl plastic and sheet steel or aluminum has been developed by U. S. Rubber's Naugatuck Chemical Div., making the metals decorative, yet permanently corrosion-proof.

The resulting laminate, called Marvinol-Metal Laminate, is said to have higher abrasion resistance than varnish, paint or baked enamel finishes. And even more important, the metal-plastic bond is strong enough to allow 180 deg. bends and deep draws with no separation. Just a few of the products envisioned are cheap, corrosion-resistant containers for chemicals, chemical piping and ducts, machine housings and building siding.

Secret of the process, of course, is the adhesive and U. S. Rubber's not talking about that, although epoxy resins are a definite possibility. Adhesion is accomplished in seconds under a heat lamp after rolling rigid or semi-rigid vinyl sheet on heated, adhesive-coated metal sheets.

To date cold-rolled steel, hot-rolled pickled steel and aluminum, from 18 to 34 gauge, have been used. Vinyl films have ranged from .002 to .02 in. thick. Tests on the finished laminate indicate an adhesion in ex-

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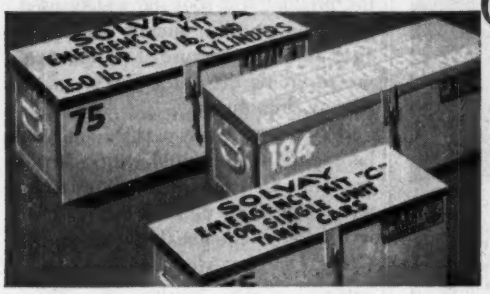

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③ Technical Bulletin Service

SOLVAY'S *exclusive* series of Chlorine technical bulletins are recognized as one of the most highly reliable sources of information on chlorine and its uses. These bulletins are: Bulletin #7, "Liquid Chlorine," Bulletin #8, "Alkalies and Chlorine in Treatment of Municipal and Industrial Water," Bulletin #11, "Water Analysis," Bulletin #12, "The Analysis of Liquid Chlorine and Bleach," Bulletin #14, "Chlorine Bleach Solutions."

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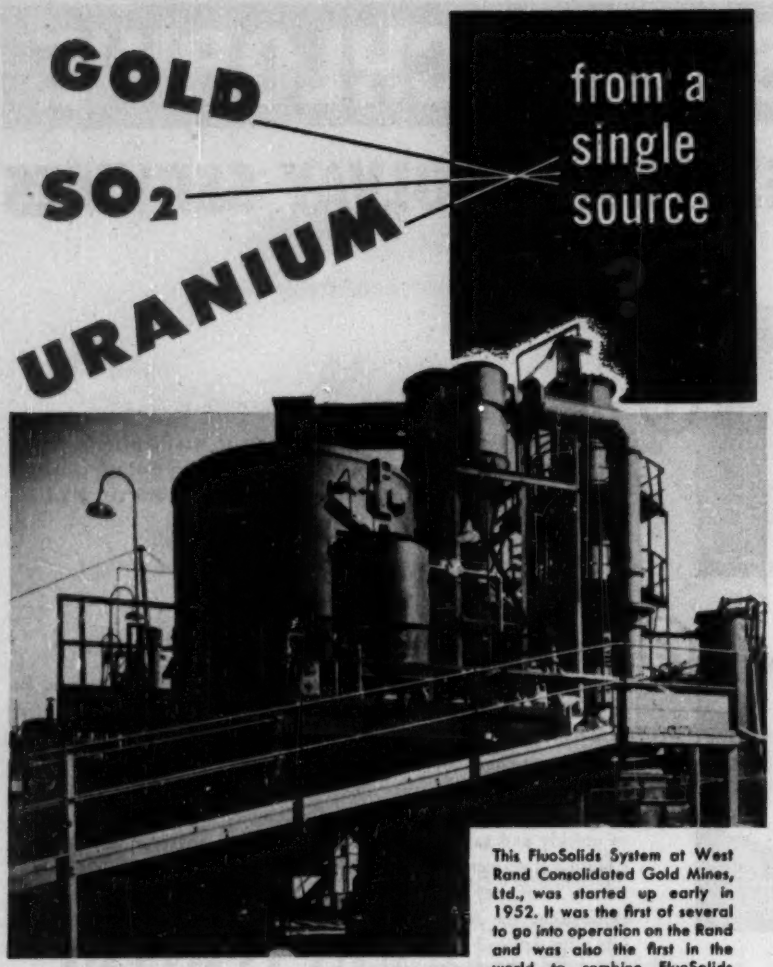

This FluoSolids System at West Rand Consolidated Gold Mines, Ltd., was started up early in 1952. It was the first of several to go into operation on the Rand and was also the first in the world to combine FluoSolids roasting of pyrites with a contact acid plant.

Gold, SO_2, Uranium . . . all from the same raw material! Improbable combination, but it's standard procedure on South Africa's fabulous Witwatersrand. Gold is recovered from ore by conventional methods; mill tailings are roasted to produce SO_2 for acid manufacture; uranium is recovered from tailings by a sulfuric acid leach.

Important part in this unique process is the Dorrco FluoSolids System, which insures a cheap, abundant source of sulfuric acid for the leaching step. Utilizing the principle of fluidization, this major advance in roasting techniques makes it possible to produce a high-strength SO_3 gas for acid manufacture from low sulfur content material.

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cess of 40 psi.—*Naugatuck Chemical Div., U. S. Rubber Co., New York 20, N. Y.*

Mold Release

For plastics formed in porous and semiporous molds.

Claimed to be the most effective release agent available for polyester, epoxy and other plastics, CD Mold Release B-2 is intended primarily for use on such porous materials as wood, polyesters, plaster of Paris and aluminum. The material, a companion to CD Mold Release B for nonporous surfaces, is quick-drying, thus permits fast molding cycles.

Biggest use to date has been in the manufacture of large polyester boat hulls, but the company expects the product will soon be widely used in the automotive, aircraft and appliance industries because of its effectiveness in filling the pores of such materials as aluminum.

B-2 is supplied as a paste and can be applied to the mold with a brush or cloth. It is insoluble in the resins, has a high flash point and high heat resistance.—*Chemical Development Corp., Danvers, Mass.*

A series of polymethoxy acetals of varying viscosities is now being offered in semi-commercial quantities. These mixed, long-chain acetals are compatible with water-insoluble plasticizers and miscible with a wide variety of organic liquids. They are suggested as plasticizers, solvents, resin modifiers and shell-molding lubricants. — *General Aniline & Film Corp., New York 41, N. Y.*

Metallic beryllium flakes (99.5 percent pure) are commercially available for the first time. Outstanding property of the flakes is high ductility which is said to make them particularly suited for fabricating beryllium by such methods as hot pressing. — *The Beryllium Corp., Reading, Pa.*

A new vinyl base cement, Vitroplast, is claimed to be completely resistant to acids (hydrochloric, phosphoric, 65 percent sulfuric, 5 percent nitric and 5 percent chromic), sodium hypochlorite, benzene, gasoline and

chlorine dioxide up to 150 deg. F. Unlike standard chemical resistant resin cements, this product doesn't require acid or alkaline setting agents. It resists oxidizing conditions at pH's ranging from 1 to 11. —*Atlas Mineral Products Co., Mertztown, Pa.*

Molybdenum disilicide, an unusual new compound that resists oxygen and does not burn, has been produced by powdered metallurgy techniques from molybdenum and silica. Because of its oxygen resistance it can be used at temperatures up to 3,000 deg. F. without employing a vacuum, whereas silicon carbide is good only up to 2,400 deg. and pure molybdenum wire, while good up to 3,600 deg., requires a vacuum. First use will be as a heating element for making glass and ceramics.—*American Electro Metal Corp., 312 Yonkers Ave., Yonkers, N. Y.*

A cleaner-corrosion inhibitor combination, Nitrox, is now available. It can be used for cleaning iron and steel cargo tanks and other containers which handle light hydrocarbons, inedible oils, solvents and inorganics. Nitrox is said to combine the efficient cleaning action of caustic soda with the inhibiting action of sodium nitrite.—*Solvay Process Div., Allied Chemical & Dye Corp., 61 Broadway, New York 6, N. Y.*

A concentrate of alkyl phenols, Alphenol, is said to be very effective in the removal of plant foliage. The new product is being used as a replacement for straight pentachlorophenol and is available as both a 90-percent oil-soluble concentrate and a 45-percent concentrate which mixes with oil and water or water alone. Defoliation of plants facilitates mechanical harvesting.—*Great Lakes Solvents, Inc., Chicago, Ill.*

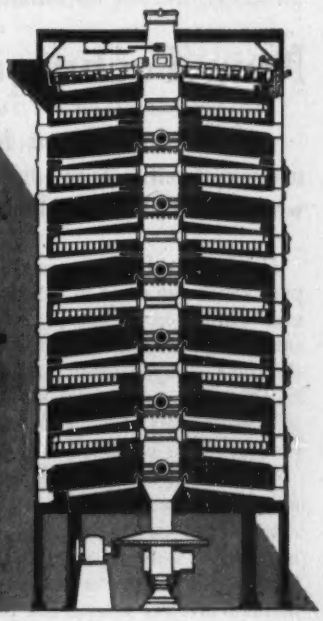
Methylene chlorobromide, an effective new fire extinguishing agent, is now in full-scale production. Commonly referred to as CB, the new agent is said to be several times as effective as carbon tetrachloride and also to have a much lower level of human toxicity. It is now being used in almost all new Air Force planes. — *Easton Chemicals Div., American Potash & Chemical Corp., Los Angeles, Calif.*

Nichols Herreshoff
Bethlehem Wedge
Sulphate Roasters

Reg. U. S. Pat. Off.

Nichols-Wedge multiple hearth roasters, with SO_2 gases downdrafted to increase sulphation, are efficiently sulphatizing copper, nickel and cobalt ores. One recent example is an installation of six 8 hearth roasters which are sulphatizing cobalt to make it water soluble, thereby effecting separation from the acid soluble oxide.

For sulphate roasting or other thermal processing requirements (equipment or engineering) the Nichols organization is at your service.



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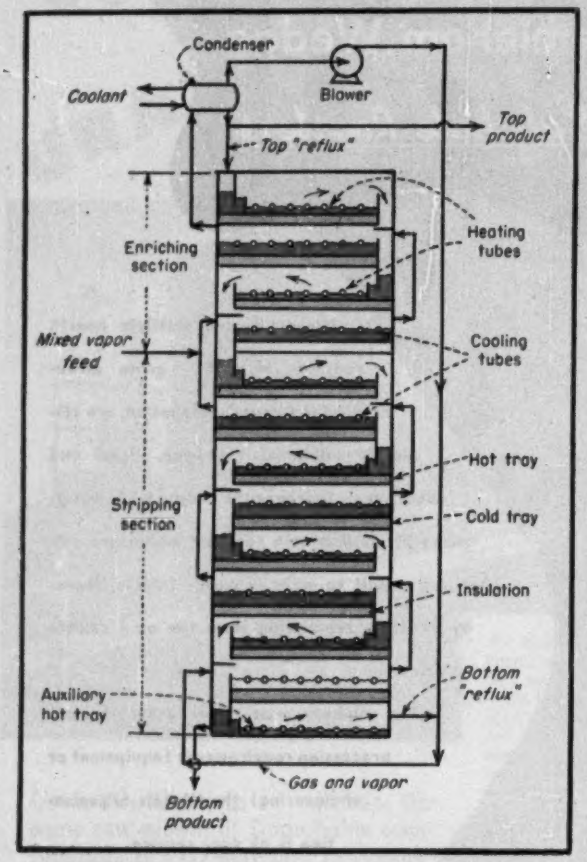
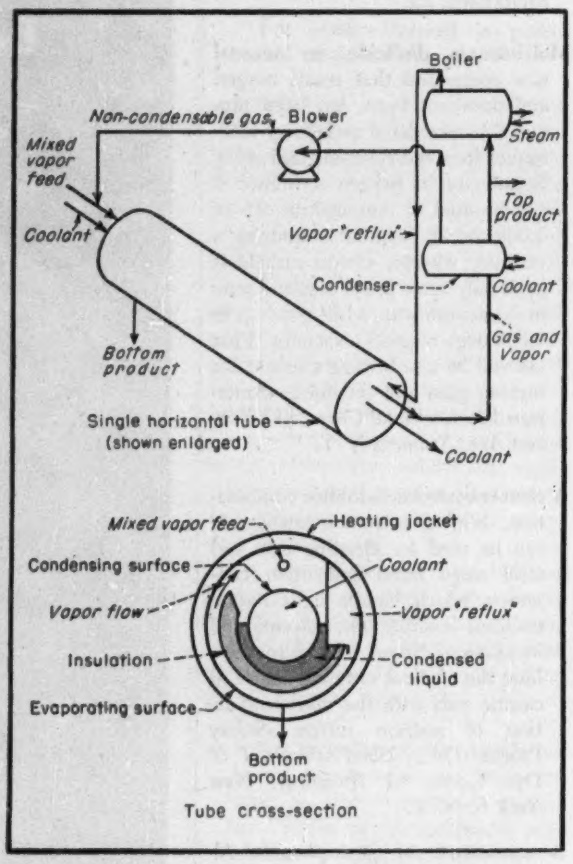


MULTI-STAGE unit has alternate hot and cold trays.



DIFFERENTIAL unit features continuous recirculation.

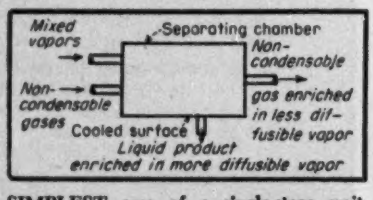
New Technique for Vapor Separation

Novel method hinges on the "filtration" of the more diffusible component through a gas. It comes in handy when distillation is not fensible.

Here's a method of separating vapors, which can come in handy whenever distillation is not practical. It involves the concentration of the more diffusible component by allowing it to diffure through a separate, filtering or screening gas. No membrane, diaphragm or slit is needed.

The new technique has been referred to as "molecular filtration" and is useful for resolving hard-to-separate mixtures of isotopes or azeotropes.

▶**How It's Done**—In general, the method involves mixing the primary vapor mixture with a secondary vapor whose dew-point is so low that it will not be condensed with any of the primary vapors. Part of the primary mixture diffuses in an unobstructed path through the secondary vapor. This divides the primary mixture into two distinct portions: One enriched in the more-diffusible component; the other enriched in the less-diffusible component.



SIMPLEST case of a single-stage unit illustrates the new technique.

The portion richest in diffusible component is condensed and withdrawn as a liquid. The other portion is removed in the vapor form. It is necessary that the filtering gas be sufficiently insoluble in the condensed vapors that it be removed at a much higher rate in the vapor form.

▶**Multiple Units**—It is possible to compound single-stage units in such a manner that a greater degree of separation is achieved. Individual

Make your pails please your customers

Tri-Sure* Container Closures prevent losses and build good will—because they *protect* your product, and make your containers easy to use and *re-use*.

Tri-Sure Container Closures offer you a line of Screw Caps, Nozzles, Spouts and Assemblies that meet every requirement for the efficient handling of containers.

Specify Tri-Sure Container Closures on every order for shipping containers. They will help your selling—as well as your packaging. For details on the complete Tri-Sure line, write to us.

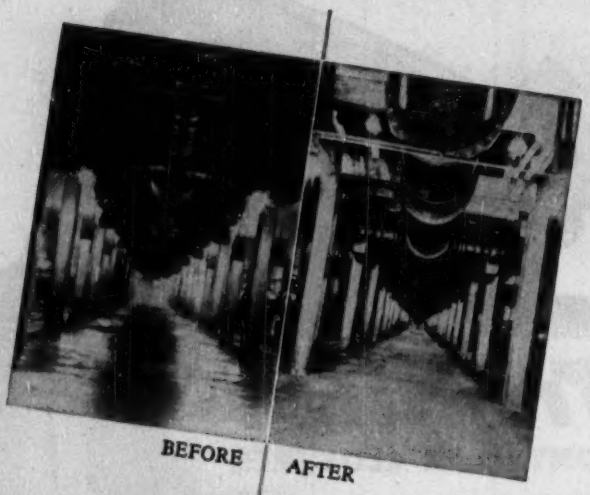
Tri-Sure Container Closures comply with I. C. C. and C. R. C. specifications

AMERICAN FLANGE & MANUFACTURING CO. INC.
30 ROCKEFELLER PLAZA, NEW YORK 20, N.Y.
Tri-Sure Products Limited, St. Catharines, Ontario, Can.

**The Tri-Sure Trademark is a mark of reliability backed by over 30 years serving industry.*

how

pipe galleries stay dry



surrounded by cold water

The pipe galleries in Chicago's water filtration plant are surrounded by Lake Michigan water, as cold as 40° F. Before Kathabar, condensation literally created a fog in the galleries, corroded expensive equipment, rotted wiring, peeled off paint.

Moisture removal by refrigeration was impractical under the conditions prevailing. Kathabar dehumidifying units completely dried up the galleries by lowering the dew point of the air. Eliminating the condensation damage, the Kathabar units pay for themselves in less than 3 years.

This is one of the many contributions of Kathabar humidity engineering. It is used for the packaging, processing, storage, and testing of many products. By preventing frost, condensation, corrosion, and supplying direct dehumidification, Kathabar saves money and improves product quality.

Wherever atmospheric moisture is a problem, Kathabar engineers will be glad to help you find a cost-saving solution.

Write for literature
Group K-53-4.

Kathabar
HUMIDITY CONDITIONING

SURFACE COMBUSTION CORP., TOLEDO 1, OHIO

ALSO MAKERS OF

Surface INDUSTRIAL FURNACES Janitrol AUTOMATIC SPACE HEATING

units may be stacked stage-upon-stage and housed in a single column. This is somewhat similar to a plate column in distillation terminology.

Each stage consists of a hot and a cold tray, forming respectively the evaporating and condensing chambers, and the vapors are passed from stage to stage. More-diffusible vapor is removed as liquid, while the less-diffusible components come off as overhead.

▶ **Differential Units**—The basic technique may also be applied to a differential column. This application (shown in the form of a multi-compartmented tube) is analogous to the packed column in distillation.

Here, again, the more-diffusible fraction is condensed while the less-diffusible component leaves as vapor. Filtering gas, separated from the vapor fraction, is recycled to the feed point.

Condensate collecting on the condensing surface falls into a trough and eventually overflows into a heated compartment, where it is revaporized. Revaporized condensate then flows countercurrent to the principle vapor mixture flow. By the continuous, countercurrent recirculation of the vaporized condensate, the more-diffusible component is continually condensed near the point of entry of the vapor mixture.

▶ **Increases Capacity**—When a vapor mixture is separated by diffusion through a porous boundary only that part which is next to the boundary has a chance to separate. With the molecular filtration technique the entire vapor mixture has the opportunity to separate. This results in a much greater separation capacity for a given size of apparatus.

▶ **Modification**—The inventor, Dr. Mario T. Cichelli, also describes a combination sweep-diffusion and molecular-filtration technique which is useful when a rough separation of a gas-vapor mixture is desired.

Dr. Cichelli has assigned his patent, U. S. 2,650,670, to Gulf Research and Development Co.

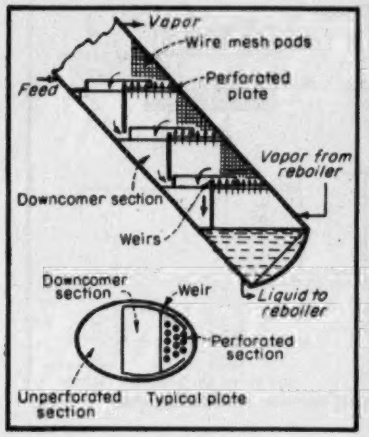
Improved Method for Recovering o-Xylene

Selective alkylation is the key to this new method of separating and recovering o-xylene from a mixture of its isomers.

The mixture is reacted with either an iso-olefin or a cyclic olefin in the

presence of an alkylation catalyst. The ortho isomer is more readily alkylated than the others and can be distilled off while in the alkylated state. It is then dealkylated.

The new recovery procedure is described in U. S. 2,648,713 by the inventor, Abraham Schneider. The patent has ben assigned to Sun Oil Co.



Tilted Tower Design Ups Throughput

Higher capacities for the same tower diameter—and no decrease in contact efficiency. That's the claim for this "leaning" tower of fractionation.

Downcomer areas of 50 to 90 percent of the superficial area of the column are possible with the new design. Compare that to the 5 to 20 percent found in the conventional tower and you've accounted for the terrific increase in capacity.

As shown in the figure, plates for the new tower are horizontal, hence elliptical. Each is divided into three sections; the solid section, the downcomer section and the perforated (or bubble cap) section.

The solid section is the bottom of the downcomer from the plate above. Liquid flows onto this section, around the downcomer section, over to the perforated portion. Here the weir ends, allowing liquid to flow over the perforations (or bubble caps). Liquid-vapor contact takes place as usual and the liquid passes over a weir, into the downcomer to the plate below.

The lower walls of the column together with a baffle define the downcomer and vapor-disengaging space for liquid overflowing each plate. The slanting design of the column provides an unusually large disengaging space.

Vapors leaving each plate pass

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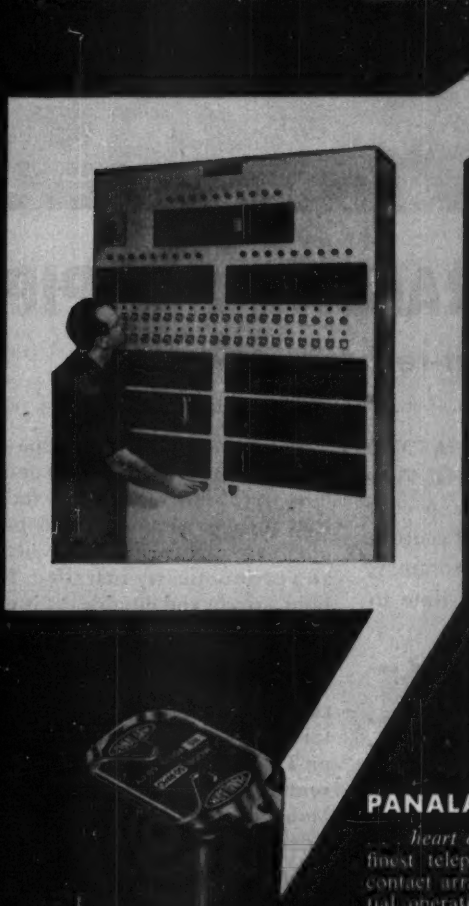
No annunciator system ever offered as much in value as PANALARM "50".

Examine for yourself every piece and component . . . consider the savings you realize through standardization and complete flexibility that only PANALARM "50" provides.

Then, evaluate *dependability*. Beyond all else, PANALARM "50" represents the greatest value in audio-visual alarm systems by its record of *dependable service* alone.

STANDARD CHASSIS

is interchangeable without re-wiring for all types of annunciator service: standard audio-visual; ringback, bullseyes or name-plates; trouble or running signals; lock-outs; or low drain operation.



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In hundreds of plants—serving for many years—Panalarm Annunciators have demonstrated outstanding performance. They have won confidence for the very critical part they play in plant operation and safety.

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. . . *heart of the system* . . . incorporate finest telephone-type relays and special contact arrangements . . . assure sequential operation. Hermetically sealed suitable for Class I, Div. 2 locations.

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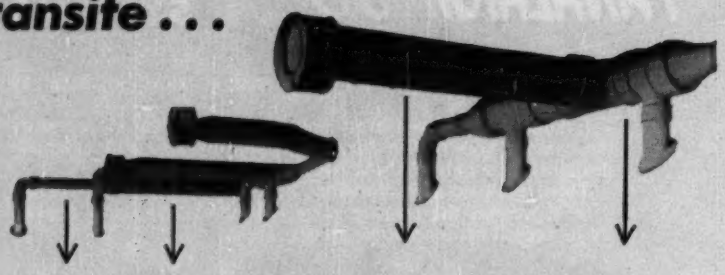
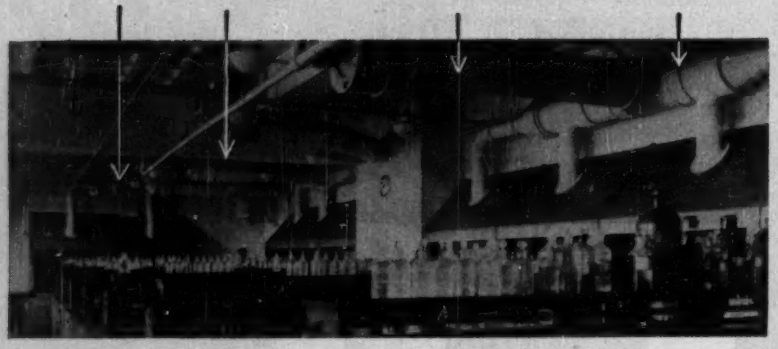


. . . a tough problem of venting corrosive fumes and gases



. . . because TRANSITE INDUSTRIAL VENT PIPE is corrosion-resistant, long-lasting

HERE ARE 3 GOOD REASONS why the Transite* Industrial Vent Pipe shown here can be expected to keep down the costs of venting aggressive gases in the laboratory, and to do it for a long time to come:

1. It's made of asbestos and cement—cannot rust or rot.
2. It needs no painting or other preservative finish—ever—whether used indoors or out.
3. It is resistant to practically all corrosive fumes, mists and gases.

Transite Industrial Vent Pipe—as vents, ducts, stacks for indoor or outdoor use in laboratories and industrial plants—is adaptable to practically any requirement. It is quickly and economically installed. It is light, strong and durable . . . is easy to assemble . . . can be worked with ordinary tools. It comes in sizes up to 36" in diameter, and there is a complete line of fittings available for every need. For further details on Transite Pipe for your industrial venting problems, write to Johns-Manville, Box 60, New York 16, N. Y.

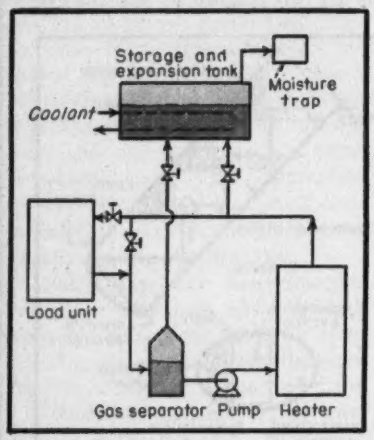
JM

*Transite is a registered Johns-Manville trade mark

Johns-Manville TRANSITE Industrial Vent PIPE

through pads of wire mesh affixed to the upper wall of the column. This reduces liquid entrainment.

The inventor, Walter H. Rupp, has assigned his patent, U. S. 2,645,467, to Standard Oil Development Co.



New Handling Method Overcomes Vapor Lock

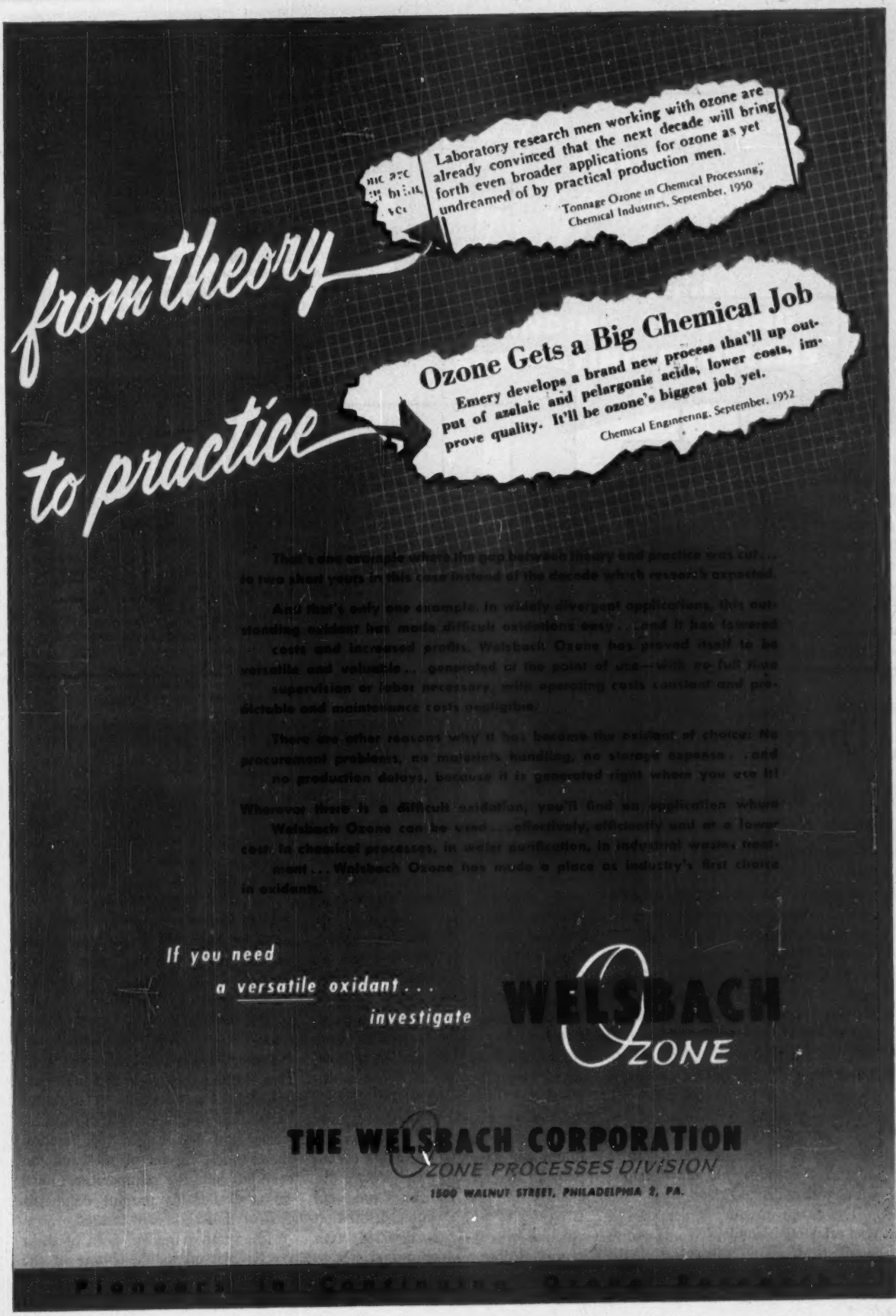
A method of eliminating vapor locking in centrifugal pumps used to circulate heat-transfer liquids has recently been described. Vapor lock, the accumulation of vapor in the pump casing, can lead to serious pumping difficulties. It can be avoided simply by separating and condensing any vapors formed, before they reach the pump.

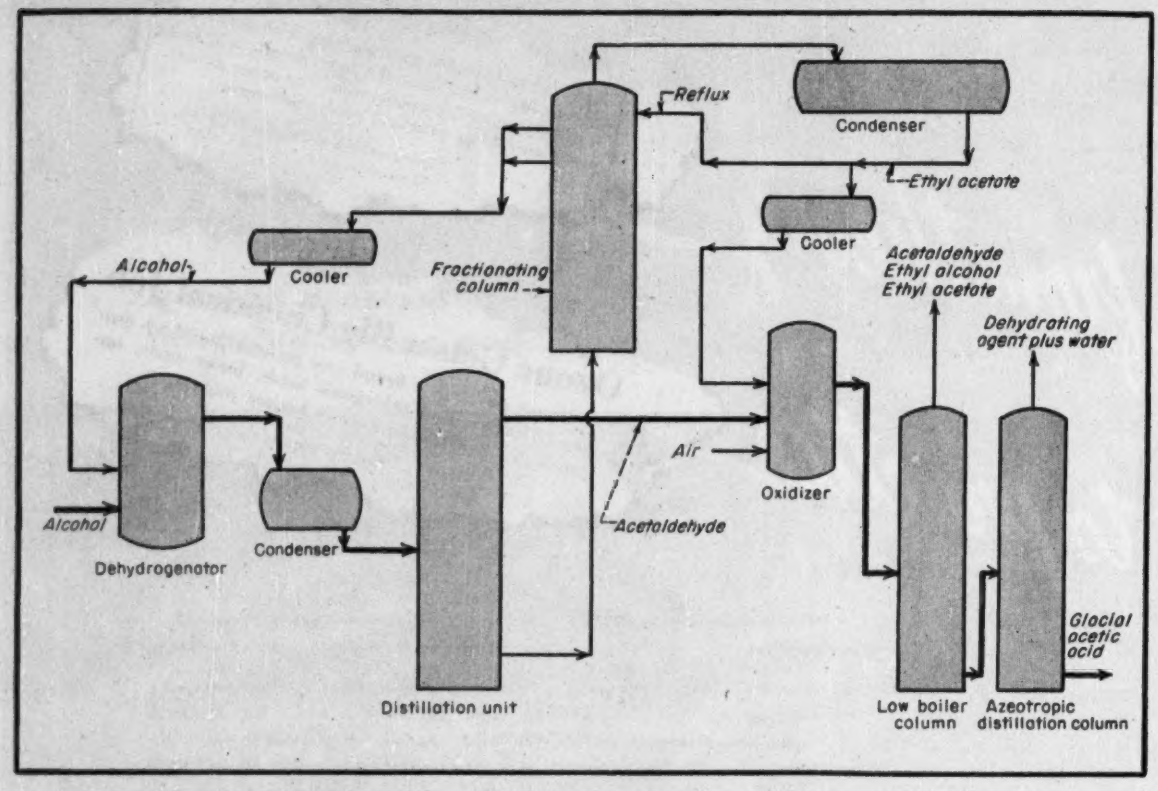
As shown above, the separator is a stationary upright tank. Gas or vapor discharged from the liquid rises in the separating tank and enters the storage and expansion tank. Here vapors are condensed.

During operation, as the heat transfer liquid gradually decomposes, the concentration of low-boiling liquids in the storage-expansion tank increases. These liquids remain substantially in equilibrium with the liquid circulating through the system, thereby repressing further dissociation without interferring with circulation.

The patent, U. S. 2,650,031, has been assigned to the John B. Pierce Foundation by the inventors, Robert A. Hitch and Ettore Da Fano.

You can obtain copies of any patents, including those mentioned here, by ordering from the Commissioner of Patents, Washington 25, D. C. They cost 25 cents each.


Laboratory research men working with ozone are already convinced that the next decade will bring forth even broader applications for ozone as yet undreamed of by practical production men.
Tonnage Ozone in Chemical Processing, Chemical Industries, September, 1950
from theory to practice
Ozone Gets a Big Chemical Job
Emery develops a brand new process that'll up output of azelaic and pelargonic acids, lower costs, improve quality. It'll be ozone's biggest job yet.
Chemical Engineering, September, 1952
If you need a versatile oxidant . . . investigate
WELSBACH OZONE
THE WELSBACH CORPORATION
OZONE PROCESSES DIVISION
1500 WALNUT STREET, PHILADELPHIA 2, PA.



Three New Ways to Produce Acetic Acid

Publicker dehydrogenates ethanol to acetaldehyde which is then oxidized. British Celanese has two methods of catalytically reacting carbon dioxide and methanol.

Three new methods of producing acetic acid have recently been revealed. Publicker Industries' process dehydrogenates ethanol to acetaldehyde and oxidizes the acetaldehyde to acetic acid. In the other two methods, both the property of British Celanese, Ltd., acetic acid is catalytically synthesized from carbon monoxide and methanol.

▶ **Publicker**—The Publicker process is shown above. Ethyl alcohol is fed into a dehydrogenating unit. It passes over a dehydrogenating catalyst at about 900 deg. F. This converts it into a mixture of acetaldehyde, ethyl acetate, water and unreacted alcohol.

The entire mixture of dehyrogenation products is condensed and sent to a still to distill off the acetaldehyde. Residue from the acetaldehyde distillation is fractionated in another column. Alcohol, substantially free of ethyl acetate, is recovered as a side cut and recycled to the dehydrogenator. Overhead, rich in ethyl acetate, is sent on to the oxidizer.

The acetaldehyde distilled from the mixture of dehydrogenation products, and the overhead from the fractionating column are sent to the oxidizer, where they are catalytically oxidized with air into acetic acid.

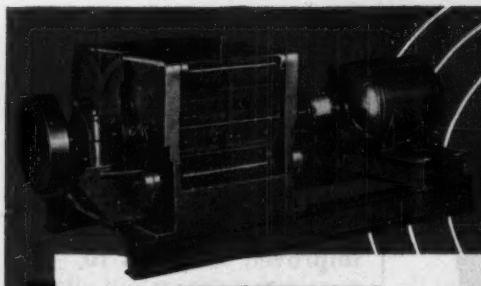
▶ **Finishing Touches**—Oxidation products are distilled to separate the crude, dilute acid from the unreacted acetaldehyde, alcohol and ethyl acetate discharged from the oxidizer. Crude acid is passed to an azeotropic distillation column where it is distilled with propyl alcohol and/or propyl acetate to produce glacial acetic acid.

▶ **British Celanese**—In each of the British Celanese methods acetic acid is catalytically synthesized directly from carbon monoxide and methanol under pressure. In one case the pressure is approximately 300 atm., while in the other it is relatively low.

▶ **High Pressure**—In the high pressure reaction methanol, carbon monoxide and hydrogen are reacted at a temperature of about 340 deg. F. to from acetic acid vapor. The temperature of this reaction must be controlled to repress the formation of methane.

▶ **Lower Pressure**—In the other reaction, carbon monoxide and methanol are reacted catalytically at pressures below 50 atm. and at temperatures below 480 deg. F. In this reaction there is less danger of methane formation, but the temperature must be controlled to prevent condensation of the acetic acid formed.

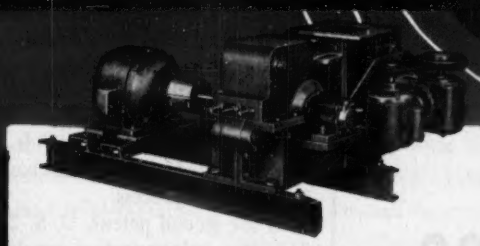
The catalyst used in both of these reactions is an iodide of one of the carbonyl-forming metals (nickel, cobalt or iron).



HAMMER MILLS

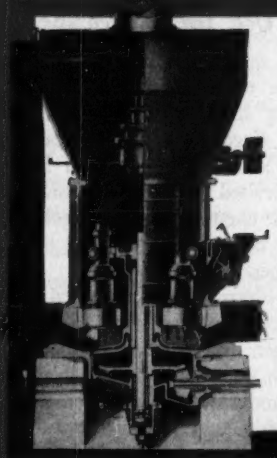
A size for every purpose! Williams Hammer Mills are designed to do the complete job in a single operation. No primary or secondary crushers required—extra foundations, conveyors, other expensive equipment are eliminated—thus saving as much as 75% on initial investment and up to 50% on grinding costs!

WILLIAMS has the *Right Answers* to all your GRINDING, CRUSHING, SEPARATING PROBLEMS



HELIX-SEAL HAMMER MILLS

Combines the advantages of a hammer mill with screw-type feed to obtain finenesses from 100 to 325 mesh. For dustless, cleaner, safer dry grinding—accurate, non-clogging reduction of sticky and wet materials. Eliminates separators, fans and cyclones. Furnished with water or steam jackets.



ROLLER MILLS WITH AIR SEPARATION

Pulverizes and blends with exceptional accuracy down to 400 mesh or micron size. Dries as it grinds. Instant size adjustment—automatic self-adjusting feed—many other exclusive features that mean improved quality and output.

Whether your job demands crushing power shovel-loaded stone to 8 mesh or smaller in a single operation—whether it is pulverizing or blending, with or without air separation, of limestone or insecticides to finenesses down to 400 mesh, or even micron sizes—whether it is closed-circuit dustless dry grinding, or the grinding of wet and sticky materials to 325 mesh—there is a Williams "proved-in service" machine that can give you **A BETTER PRODUCT—FASTER PRODUCTION—and LOWER COSTS.**

It will pay you to get the facts about Williams equipment, and learn what it can do for your specific operation. **Write Today For Literature.**

Send Us Your Questions

Complete testing and research facilities are maintained by Williams to develope the **right answers**, especially for your operation, on every size reduction problem. Write for information and the help of an experienced Williams technician.

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Lightweight and corrosion-resistant, Weldco is available in Monel, Stainless, Inconel, Nickel and other alloys, in sizes from 3½" to 30" O. D., 16 ga. to ¼" wall thickness. To insure top performance and long service life, make Youngstown Welding your tubing headquarters. A letter or phone call puts our 36 years of specialized experience to work for you.

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The Publicker method was patented by Jacob L. Stein in U. S. 2,650,244. The British Celanese patents, U. S. 2,650,245 and U. S. 2,650,246, were awarded to Edward B. Thomas and Edmund H. Alcock.

Improved Catalysts to Speed Dacron Production

Two recent patents involving catalysts for use in the production of polyethylene terephthalate (Dacron) have been assigned to the Du Pont Co.

The first patent, U. S. 2,647,885, describes the use of catalytic amounts of antimony trioxide to accelerate the polymerization rate of the monomer, bis-2-hydroxy-ethyl terephthalate. The monomer is prepared by reacting ethylene glycol with an alkyl ester of terepthalic acir under ester interchange conditions. The monomer is then polymerized. Heretofore this has been a rather slow process.

In the second patent, U. S. 2,650,-213, the polymerization reaction is carried out in the presence of a catalyst system consisting of litharge, antimony trioxide and triphenyl phosphite.

U. S. 2,647,885 is the invention of Harry R. Billica, while U. S. 2,650,-213, is the invention of Charles H. Hofrichter.

New Use for Hydrazine

You may soon see "internal combustion engine fuel" added to the growing list of uses for hydrazine. Two Czechoslovakian researchers, Libor Mikulasek and Milan Strnad, have devised a method of using this versatile chemical in its new role.

The new method involves two energy-liberating steps.

- Hydrazine is decomposed by an electrical discharge into a mixture of hydrogen, nitrogen and ammonia.
- Air or oxygen is introduced and the products of the decomposition step ignited.

The two explosions may be made to occur either simultaneously or in sequence. In order to have them occur simultaneously the oxygen is simply mixed with hydrazine fed to the appartus.

The patent, U. S. 2,648,317, describes the modifications which would have to be made to a conventional engine to handle the new fuel.

EVAPORATION in SECONDS!

The unique Rodney Hunt Turba-Film Evaporator gives incredibly fast one-pass evaporation of liquids, slurries and gases... especially heat-sensitive substances... all by continuous process!

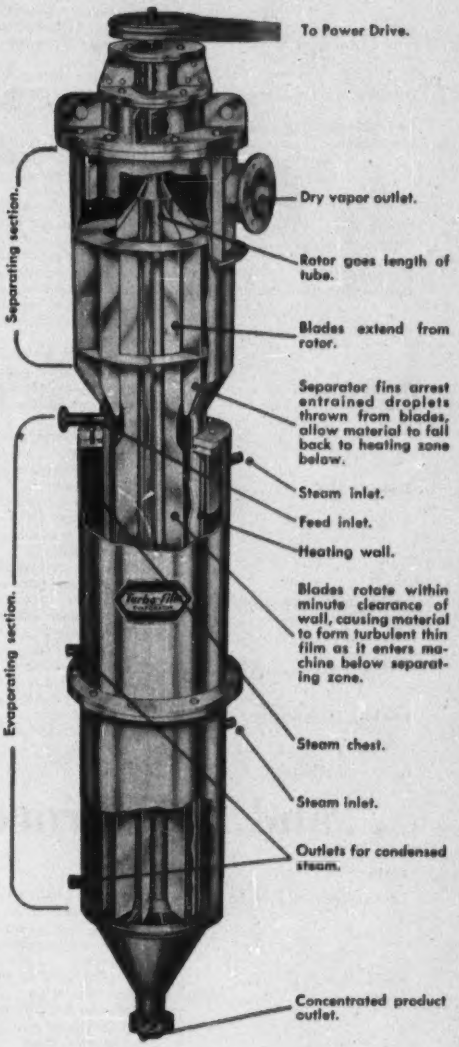
The Turba-Film Evaporator employs a totally different concept of evaporation. Makes heretofore extremely difficult evaporating processes simple and rapid. Actually evaporates most substances in a few seconds!

Here's how the patented Turba-Film® works. The substance to be evaporated is fed into the evaporating section. Here it is whirled against the wall by controlled-speed rotor blades. This forms a thin turbulent film, centrifugally held to the wall, which spins in a gravity flow through the chamber and out... completing the process. The vapors rise into the separating section where rotor blades beat out any entrained droplets and force them back through the evaporating section.

So thorough is this Turba-Film process that no substance requires re-circulation... the desired concentration is achieved in one pass! So fast is the Turba-Film action that proper heating is done in seconds. Colors, flavors, nutritional and other valuable properties are retained to a much higher degree... especially in heat-sensitive substances.

Because of its new principle, the Rodney Hunt Turba-Film Evaporator (Luwa Process, Switzerland) permits quick change-over from one product to another; prevents foaming and frothing difficulties; allows constant quality control to be maintained; permits concentration to very much higher viscosities and solids content than is practical with conventional equipment.

Please consider our complete engineering staff at your disposal for consultation on any possible Turba-Film application. We have the facilities for making test runs in our pilot plant: or we can provide a portable laboratory unit for use in your own plant. Mail this coupon for free color brochure explaining the Turba-Film Evaporator in detail.


To Power Drive.
Separating section.
Dry vapor outlet.
Rotor goes length of tube.
Blades extend from rotor.
Separator fins arrest entrained droplets thrown from blades, allow material to fall back to heating zone below.
Steam inlet.
Feed inlet.
Heating wall.
Evaporating section.
Blades rotate within minute clearance of wall, causing material to form turbulent thin film as it enters machine below separating zone.
Steam chest.
Steam inlet.
Outlets for condensed steam.
Concentrated product outlet.

Models available in ranges from 40 to 2500 pounds of water evaporation per hour. Stainless steel construction.

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Please send Free brochure giving details of Turba-Film Evaporator

Name.....Title.....

Company.....

Address.....

City.....Zone.....State.....

Type of Industry.....Product.....

☐ I want details on your testing program. CE 12-53

Your Checklist of New Equipment Patents

Operation . . .	About . . .	Inventor or Assignee . . .	Patent No. . .
Adsorption	Apparatus for stripping and regenerating spent adsorptive powders	Shell Development Co	2,650,155
	Fractionation with solid adsorbents	Standard Oil Development Co	2,651,603
Chemical reaction	Apparatus to produce calcium superphosphate	F. Streichen and A. Debaisieux	2,650,028
Concentrating	Controlling the density of the apex discharge of a hydraulic cyclone	The Dorr Co	2,648,433
	Concentrator for ores	Allan E. Jones	2,649,202
Crushing and grinding	Apparatus for vibratory grinding	F. S. Smidth & Co	2,650,033
	Centrifugal grinding mill	H. H. and H. M. Manufacturing Co	2,651,471
Crystallization	Sugar crystallizer	Luis M. I. Rodrigues	2,650,175
Distillation	Detachable vane assembly for contact column	Ben Bartolucci	2,649,291
	Bubble cap and riser assembly	C. F. Braun & Co	2,650,809
	Gas-liquid contacting apparatus	L'Air Liquide	2,651,512
Drying	Rotary steam drier	Fanny M. Engstrom	2,648,914
	Apparatus for discontinuous drying using a cooling cycle	Aktiebolaget Enkopings	2,649,789
Evaporation	Evaporators for sea water	The Maxim Silencer Co	2,649,408
Filtration	Filter bottom	The Permutit Co	2,648,439
	Cleaning filter sand beds	Wittichen Chemical Co	2,648,440
Flotation	Dual aerating flotation machine	Mining Process and Patent Co	2,651,413
Fluid and particle flow	Operating procedure for gas lifting granular materials	Houdry Process Corp	2,649,340
	Contacting gases and solids	The M. W. Kellogg Co	2,649,358
	Device for visual observation of dense phase solids-in-gas suspensions	United States Government	2,650,562
	Apparatus for the uniform distribution and contacting of subdivided solid particles	Universal Oil Products Co	2,651,565
Gas-liquid separation	Centrifuge for separating gases from liquids	American Cyanamid Co	2,648,496
Gas-solids separation	Electrical precipitator	Research Corp	2,648,394
	Dust collector	Herbert Simpson Corp	2,649,924
	Electrostatic precipitator	Westinghouse Electric Corp	2,650,672
	Dust collector	E. W. Thrailkill	2,650,674
	Apparatus for separating solid particles from gases	Bituminous Coal Research, Inc	2,650,675
Heat transfer	Heat exchanger	O. A. Carnahan	2,648,527
	Heat control in vertical furnace by flue gas recirculation	Petro-Chem Process Co., Inc	2,648,599
	Heat exchanger with beam components	The Air Preheater Corp	2,650,076-7
	Cooling tower with splash deck-supported basin	The Marley Co., Inc	2,650,082
	Heat exchanger	Michael B. Collito	2,650,801
	Countercurrent heat exchanger	Andre Huet	2,650,802
	Heat exchanger for slurrys	William M. Bready	2,651,508
Instrumentation and control	Recording refractometer	Monsanto Chemical Co	2,649,012-4
	Fluid flowmeter with heated resistance bridge circuit	Phillips Petroleum Co	2,650,496
	Flexible pitot-static tube	Research Corp	2,650,497
	Flow controller for granular solids	Phillips Petroleum Co	2,650,693
Mixing	Apparatus for dissolving solutes in liquids	Shell Development Co	2,649,203
	Rotary tumbling mill	Alfred J. Schaefer	2,650,805
	Mixing device for stirring pigments in paint	Orlando H. Lind	2,651,510
Solid-liquid separation	Vortical separator	Stamicarbon N. V	2,649,963
	Sedimentation apparatus	The Dorr Co	2,650,707

. . . and New Process Patents

Product . . .	Process . . .	Inventor or Assignee . . .	Patent No. . .
Fats and oils	Preparation of synthetic drying oils	Standard Oil Development Co	2,650,209
	Removing metallic contaminants from hydrogenated oils	The De Laval Separator Co	2,650,931
	Preparing metallic soaps of fatty acids	National Lead Co	2,650,932
	Liquid-liquid extraction of mono-from di- and triglycerides	Colgate-Palmolive Peet Co	2,651,646
Fuels	Carbonization of peat with heat recovery	Michael Steinschlaeger	2,650,190
Gases	Rectification of air	Hydrocarbon Research, Inc	2,648,205
	Absorption of CO_2 from gas mixtures with a polyglycol ether	Allied Chemical & Dye Corp	2,649,166
	Fractionation of air	The M. W. Kellogg Co	2,650,481-2
	Fractionation of air	The British Oxygen Co	2,650,483
Hydrocarbons	Azeotropic distillation to recover aromatic fractions containing naphthalene	The Texas Co	2,648,624
	Reforming process and catalyst	The Atlantic Refining Co	2,651,598
Inorganic chemicals	Production of NaO_2	William H. Schechter	2,648,596
	Calcining lime-bearing sludges	The Dorr Co	2,650,084
	Purification of calcium	Imperial Chemical Industries Ltd	2,650,085
	Production of ammonium uranium fluoride	Imperial Chemical Industries Ltd	2,650,153
	Production of sulfur from H_2S	Tide Water Associated Oil Co	2,650,154
Metals and ores	Concentration of copper oxide ores with nitrites	Joseph J. Kasevniak	2,648,431
	Treating arsenical gold ores	The Dorr Co	2,650,159
	Electrowinning chromium	Union Carbide & Carbon Corp	2,650,192
	Separation of nickel from nickel-cobalt alloys	Societe Generale Metallurgique de Hoboken	2,651,562
Organic chemicals	Low-temperature emulsion polymerization of unsaturated organic cpds	Hercules Powder Co	2,648,655-8
	Preparation of aralkyl carbonates	Ohio-Apex, Inc	2,648,678
	Production of esters of cyclic acetals	Atlas Powder Co	2,648,680
Resins	Production of melamine	Allied Chemical & Dye Corp	2,649,446
	Preparation of water-soluble urea-aldehyde condensation products	Deutsche Gold- und Silber-Scheideanstalt vormals Roessler (Degussa)	2,650,910
	Heat-treating coagulated thermoplastic polymer latices	The Distillers Co. Ltd	2,650,912
Rubber	Preparing rubber stabilizers	Standard Oil Development Co	2,650,208
Synthesis gas and synthesis products	Higher fatty acid synthesis from oxo bottoms	Standard Oil Development Co	2,648,694
	Hydrocarbon synthesis and synthesis gas production	Hydrocarbon Research, Inc	2,649,468
	Catalytic synthesis of hydrocarbons and oxygenated organic cpds	The Texas Co	2,651,652
	Two-stage hydrocarbon synthesis	Standard Oil Development Co	2,651,653

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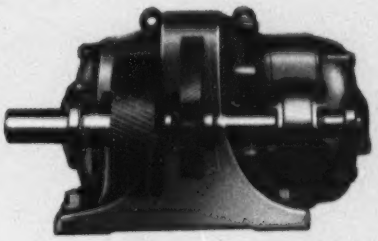
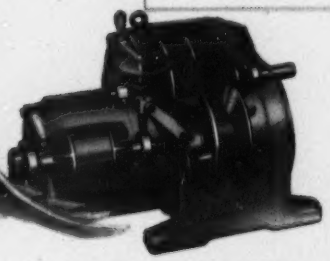
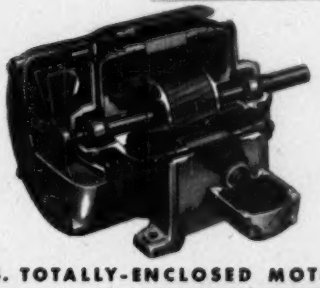


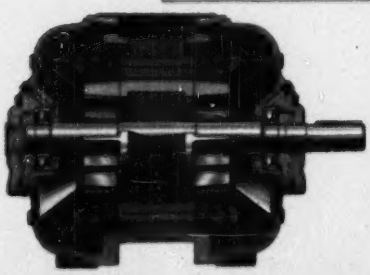
U. S. SYNCROGEAR MOTOR



U. S. VARIDRIVE MOTOR



U. S. TOTALLY-ENCLOSED MOTOR



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Extra life without extra cost

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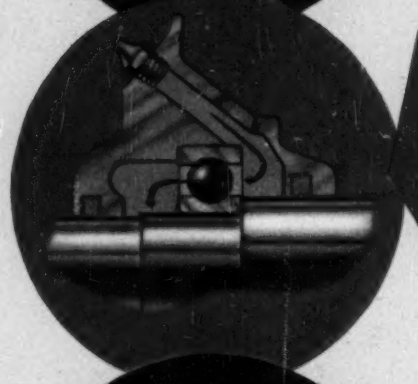

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NORMALIZED CASTINGS

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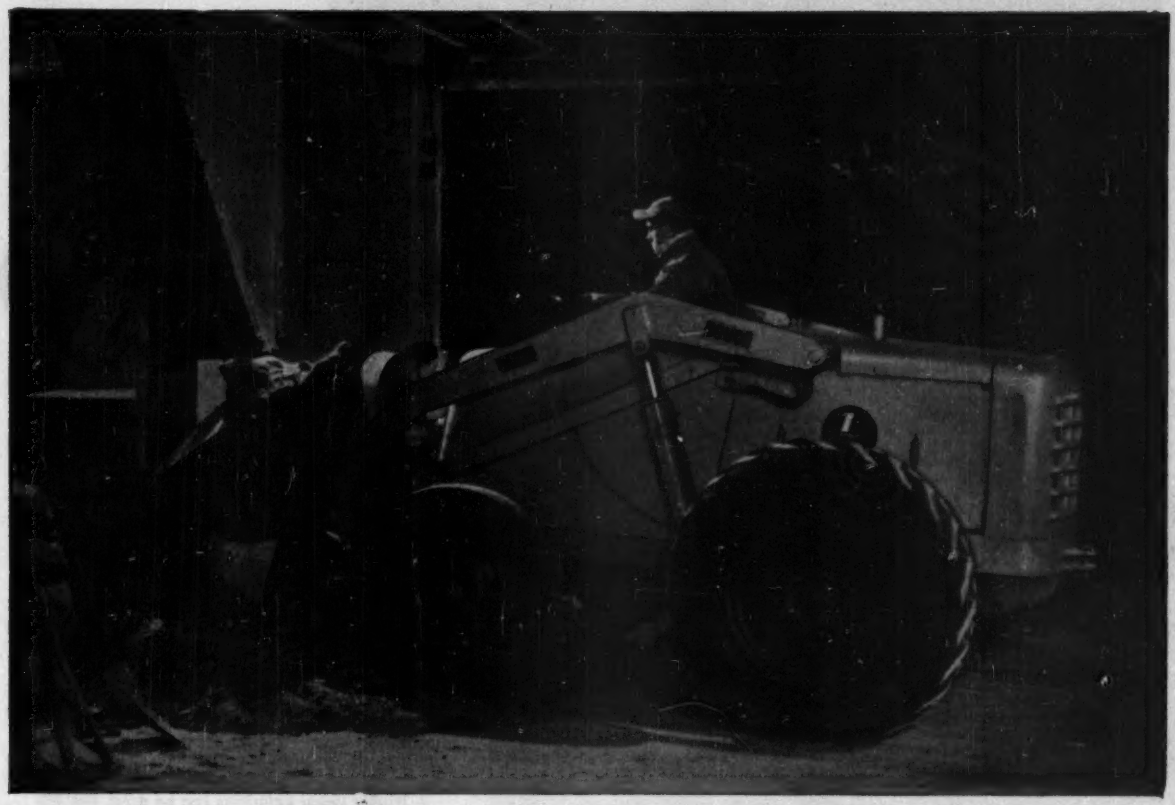

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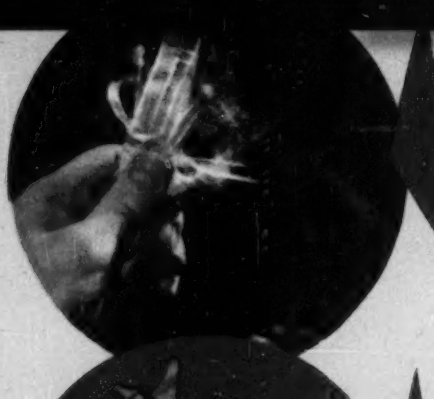

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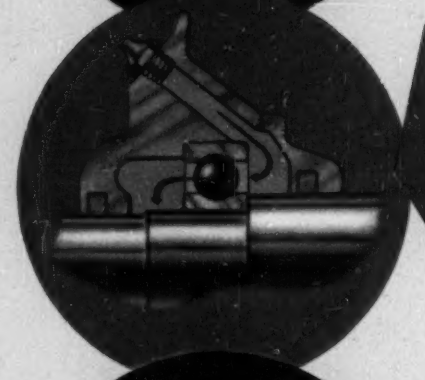

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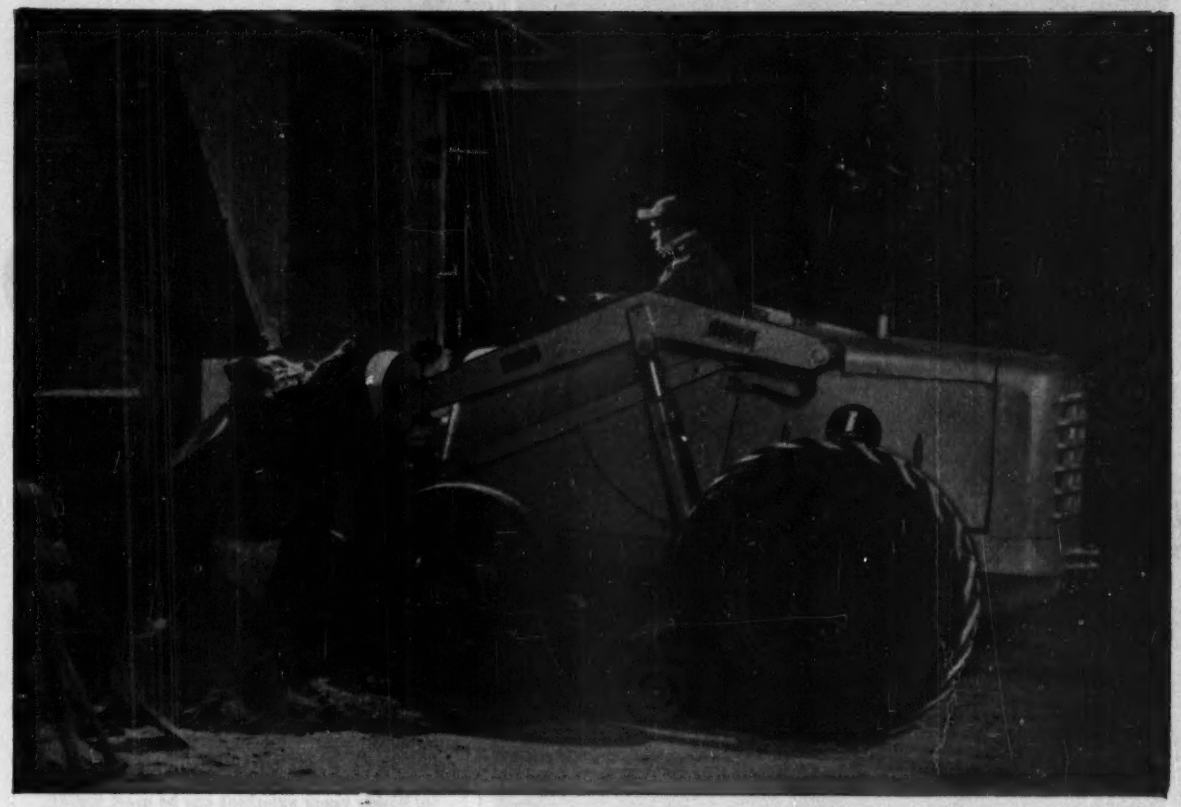

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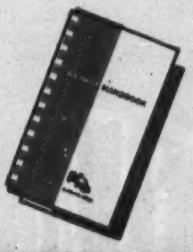

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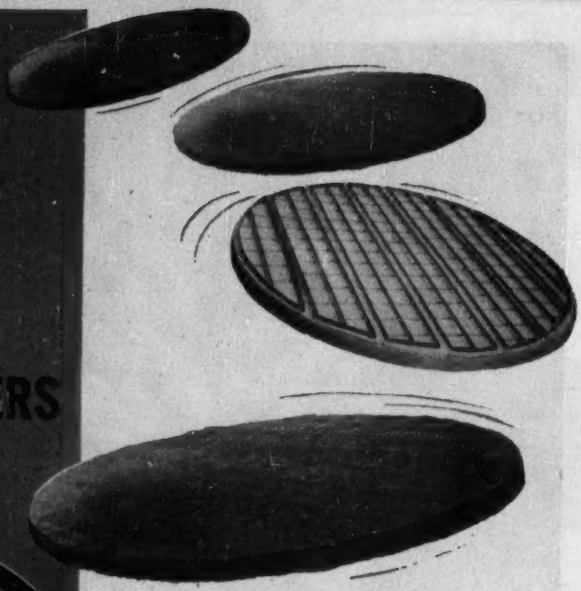

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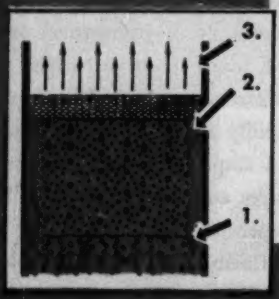

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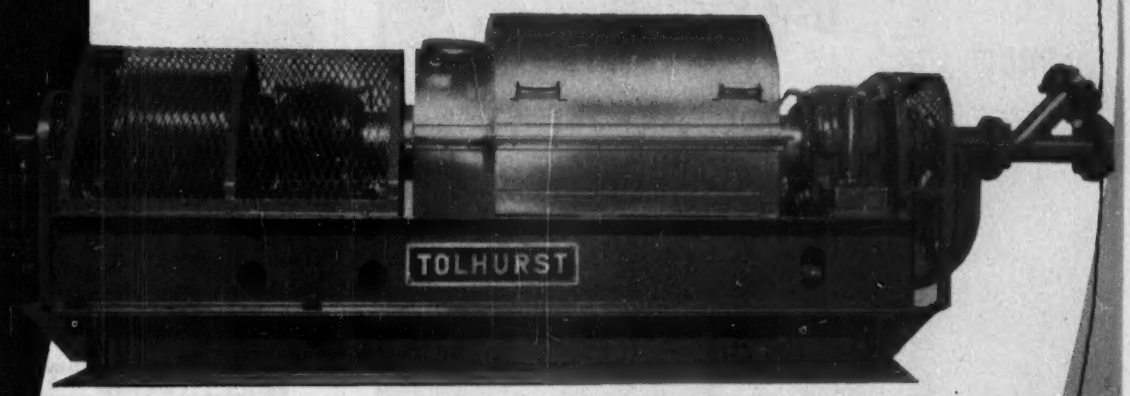

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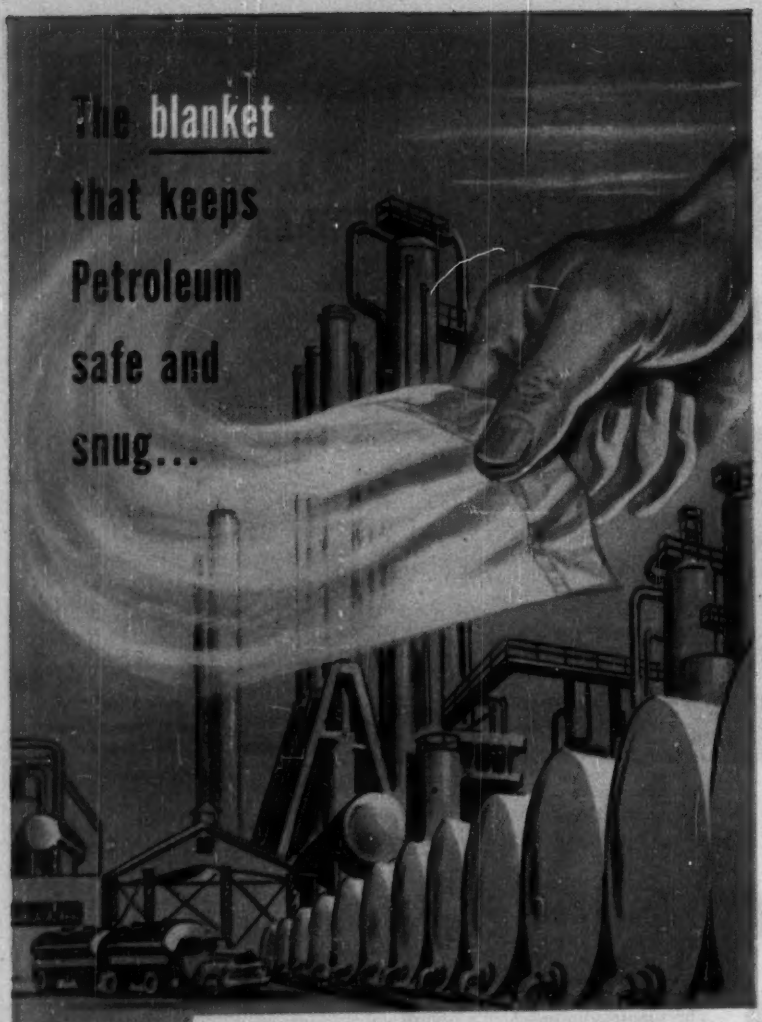

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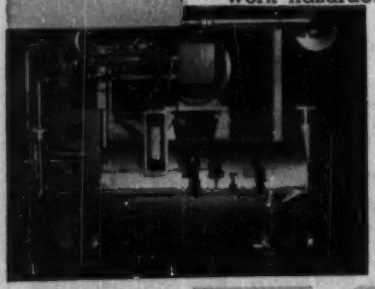

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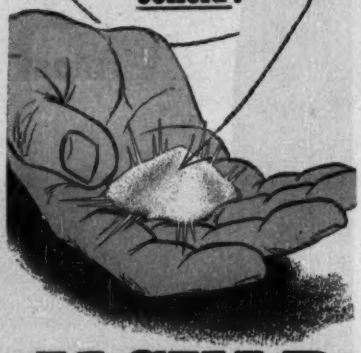

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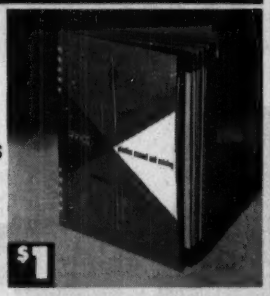

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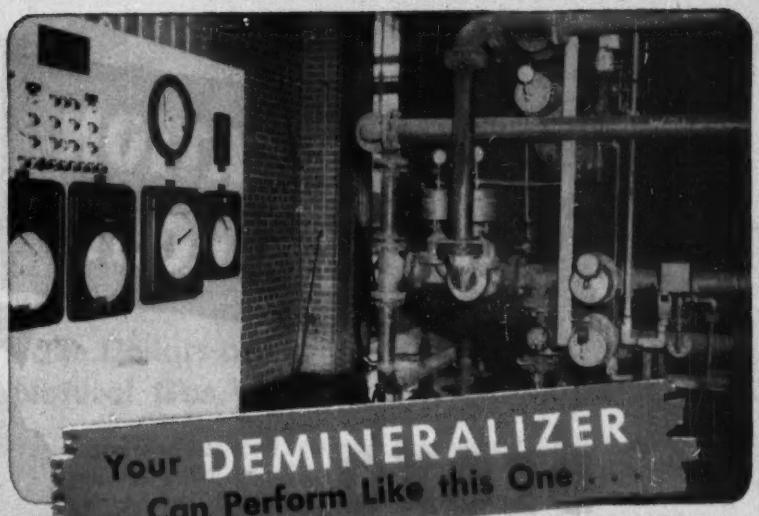

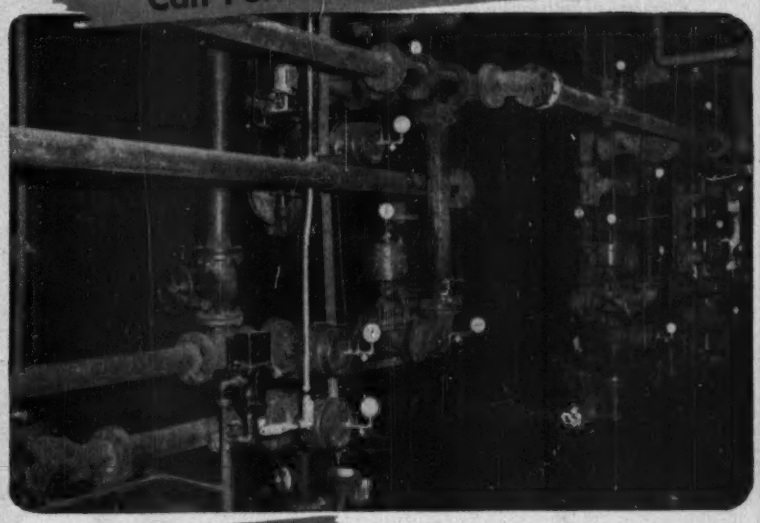

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ION EXCHANGE RESINS

500 gallons per minute of clarified Missouri River water are completely deionized for 100% make-up to a 1250 psig boiler by this Nalcite-charged unit at a large Midwestern utility. Whether your water conditioning problem is large or small, Nalcite HCR cation exchange resin, together with either Nalcite SAR or SBR anion exchanger gives you performance that means longer on-line operation, with removal of both strong and weak acids including silica.

Full information on Nalcite Ion Exchange Materials is yours for the asking. Write today.

**Reg. Trademark of the Dow Chemical Company*

NATIONAL ALUMINATE CORPORATION
6216 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

Nalco®

PRODUCTS • *When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology*

GAS PURIFICATION AT REDUCED COST!

DEOXO GAS PURIFIERS

Catalytic Operation at High or Low Pressure

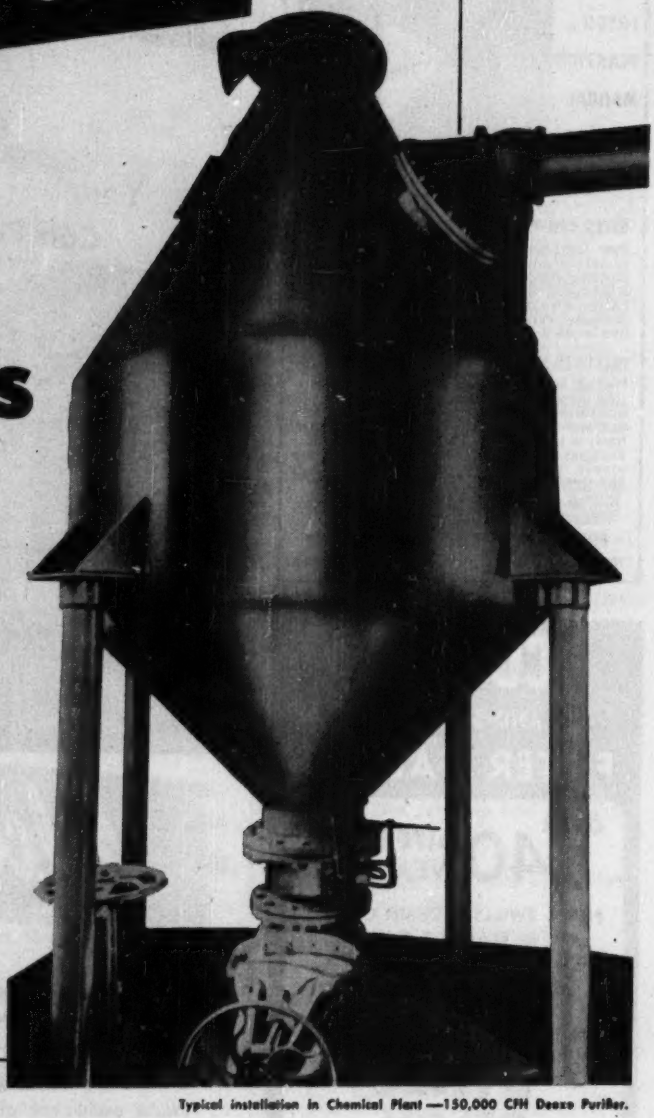
AT ROOM TEMPERATURE...
Removal of Oxygen and/or Hydrogen

AT 125° CENTIGRADE...
Conversion of CO to CO_2

AT 250° CENTIGRADE...
Methanation of CO to CH_4

AVAILABLE CAPACITIES: 25 CFH to 500,000 CFH

NO MAINTENANCE COST
NO OPERATING COST
NO REACTIVATION

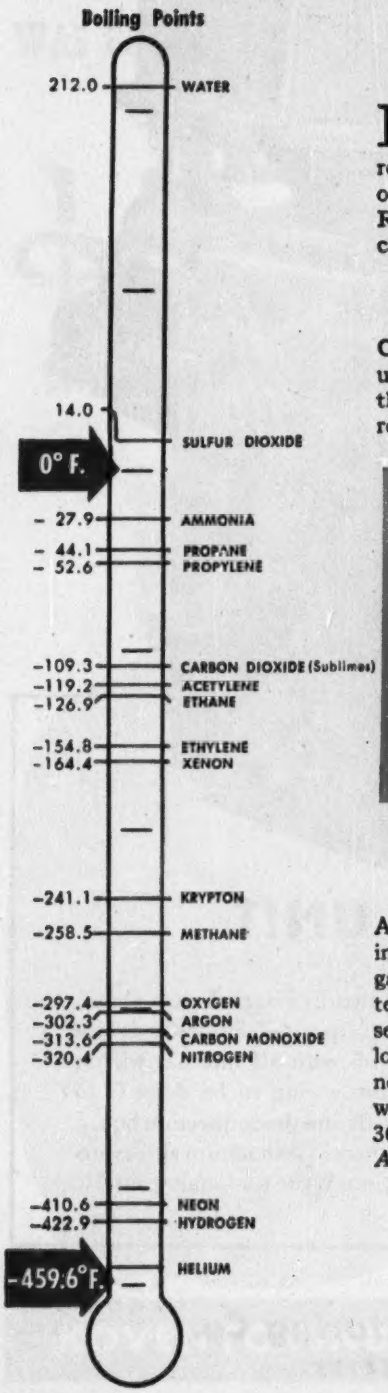


Typical installation in Chemical Plant—150,000 CFH Deoxo Purifier.

BAKER & CO., INC.

113 ASTOR STREET, NEWARK 5, NEW JERSEY
NEW YORK • SAN FRANCISCO • LOS ANGELES • CHICAGO

NEW PROFITS thru Low-Temperature Liquefaction and Separation of Gases

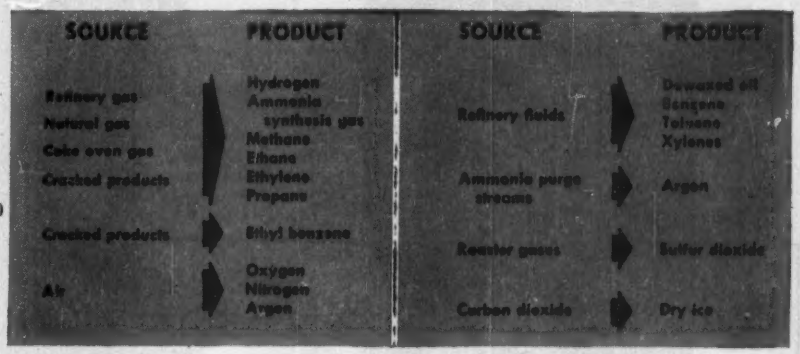


Take Dollars out of By-Product Gases, Natural Gas, Air; Cut Storage Costs

Low-temperature processes open new profit possibilities for the chemical, petroleum, steel and related industries. They make it feasible to recover valuable products from many gas mixtures . . . or, used in place of other recovery methods, widen profit margins. (See examples in chart.) Reduced to a liquid state by low temperatures, gases such as natural gas can also be *stored* at less cost.

What Can Low Temperatures Do For You?

Consider your fluid flows, or mixtures you now dispel or burn as waste, use for fuel, or can get at low cost (natural gas) or *no* cost (air). Can these "resources", plus low-temperature processing, provide additional revenue?



Consulting-Design Engineering Service

Ask *Air Products* to survey your low-temperature possibilities. Leader in its field, *Air Products* has designed and built over 600 low-temperature gas separation plants. Our more than 100 engineers—specialists in low-temperature process engineering and mechanical design—are at your service. We can supply a *preliminary engineering analysis* of your low-temperature possibilities . . . or a *complete process design*. Engineering rates are reasonable. Outline your problem to us (your inquiry will incur no obligation), or write on company letterhead for NEW 36-page BROCHURE. *Air Products, Inc., Dept. F, Box 538, Allentown, Pa.*

Air Products
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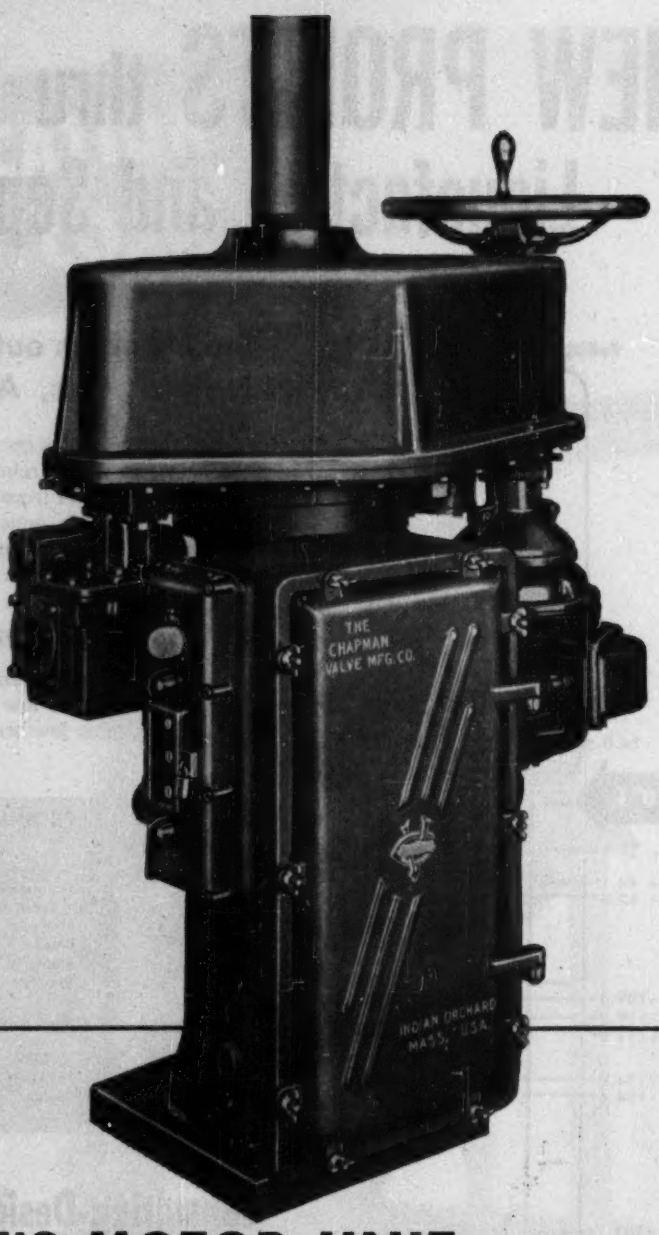
Specialists in Low-Temperature Processing

Estimates • Process Design • Apparatus Design • Apparatus Manufacture

SMART OPERATOR for Valves, Gates and Floorstands



CHAPMAN'S MOTOR UNIT

Instant control of valves and large sluice gates at the touch of a button . . . that's what you get with Chapman Motor Units on the job. Completely housed and thoroughly dust and weather proof, these units are built "to take it" for years, on the roughest service. They're designed for simplicity and extreme ruggedness, as shown by internal view above.

Chapman Motor Operated Floorstands are delivered to the job with all internal wiring complete, so all the wiring to be done is to bring the power leads into the connection box... saving time and money in installation and assuring proper operation. Write for Catalog No. 50.

The Chapman Valve Manufacturing Co.
INDIAN ORCHARD, MASSACHUSETTS

BACK IN THE 1880's

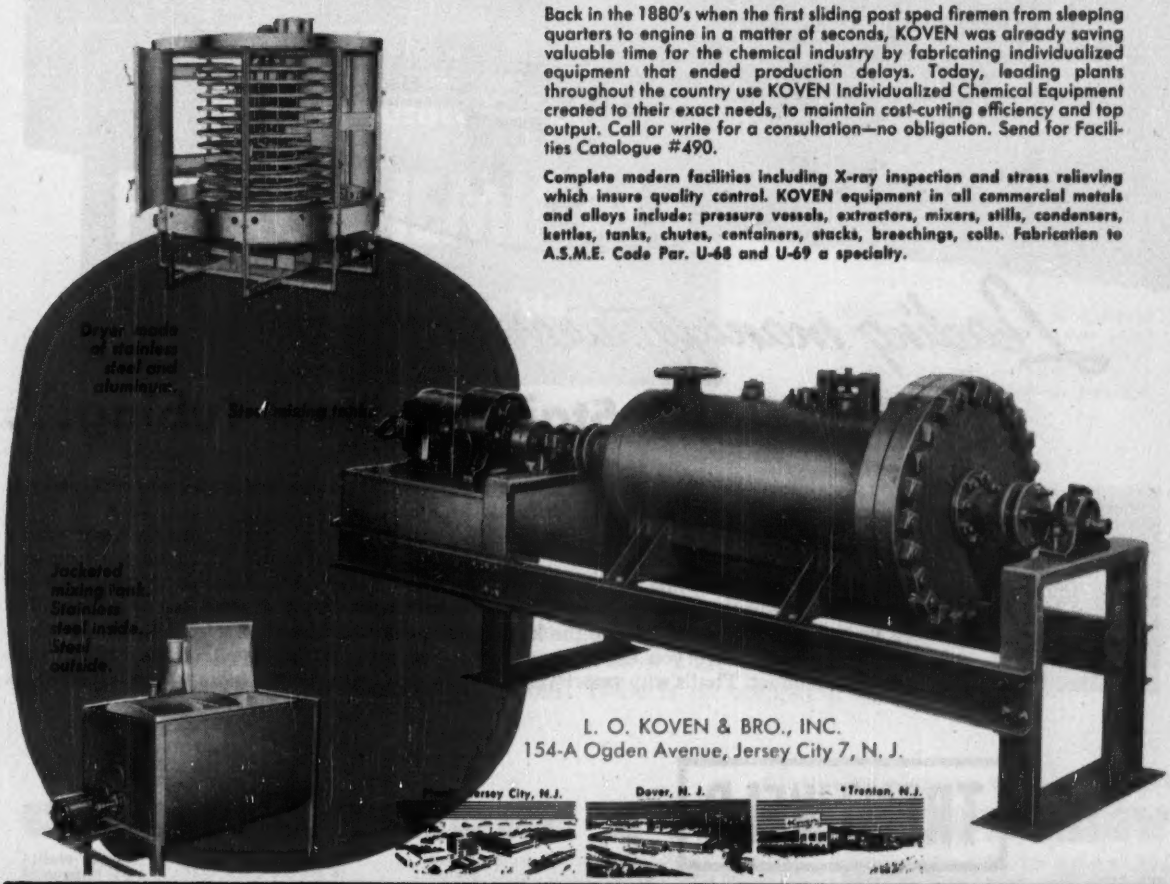
WHEN THE FIREMAN'S SLIDING POST WAS FIRST ADOPTED

Koven

WAS MAKING INDIVIDUALIZED CHEMICAL EQUIPMENT

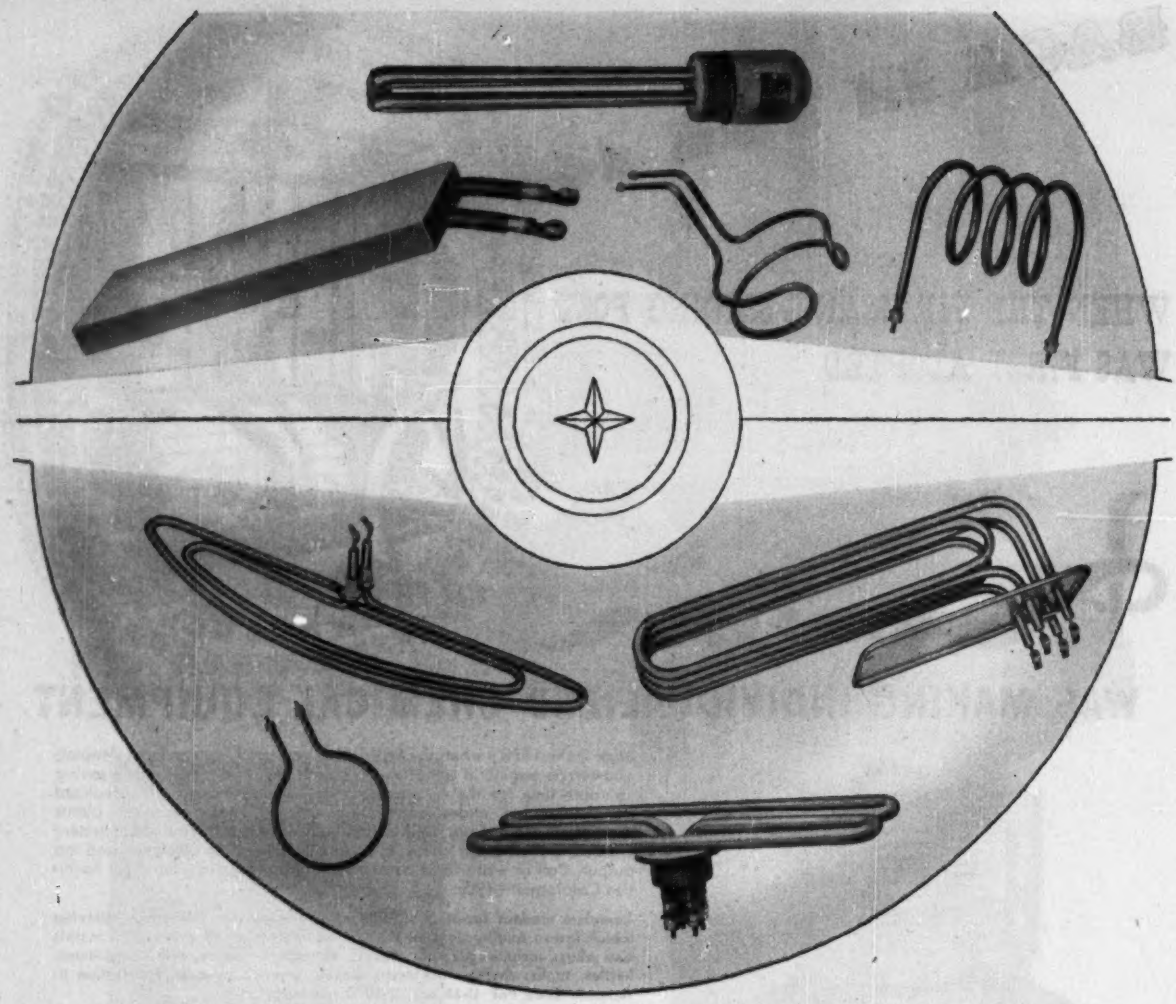
Back in the 1880's when the first sliding post sped firemen from sleeping quarters to engine in a matter of seconds, KOVEN was already saving valuable time for the chemical industry by fabricating individualized equipment that ended production delays. Today, leading plants throughout the country use KOVEN Individualized Chemical Equipment created to their exact needs, to maintain cost-cutting efficiency and top output. Call or write for a consultation—no obligation. Send for Facilities Catalogue #490.

Complete modern facilities including X-ray inspection and stress relieving which insure quality control. KOVEN equipment in all commercial metals and alloys include: pressure vessels, extractors, mixers, stills, condensers, kettles, tanks, chutes, containers, stacks, breechings, coils. Fabrication to A.S.M.E. Code Par. U-68 and U-69 a specialty.



L. O. KOVEN & BRO., INC.
154-A Ogden Avenue, Jersey City 7, N. J.

KOVEN FOR INDIVIDUALIZED EQUIPMENT SINCE 1881



Leading manufacturers specify

TRENTWELD Stainless Steel Tubing...

TRENTWELD stainless steel heat-resistant tubing was chosen by Cutler-Hammer, Inc., for the vital heating units in the new *Bendix* Duomatic washer-dryer.

Exposed to high operating temperatures, moisture and corrosive agents week after week, heating units have to be good to give the kind of long dependable service you expect from a famous-name product. That's why TRENTWELD's excellent corrosion and heat-resistance make it an ideal choice.

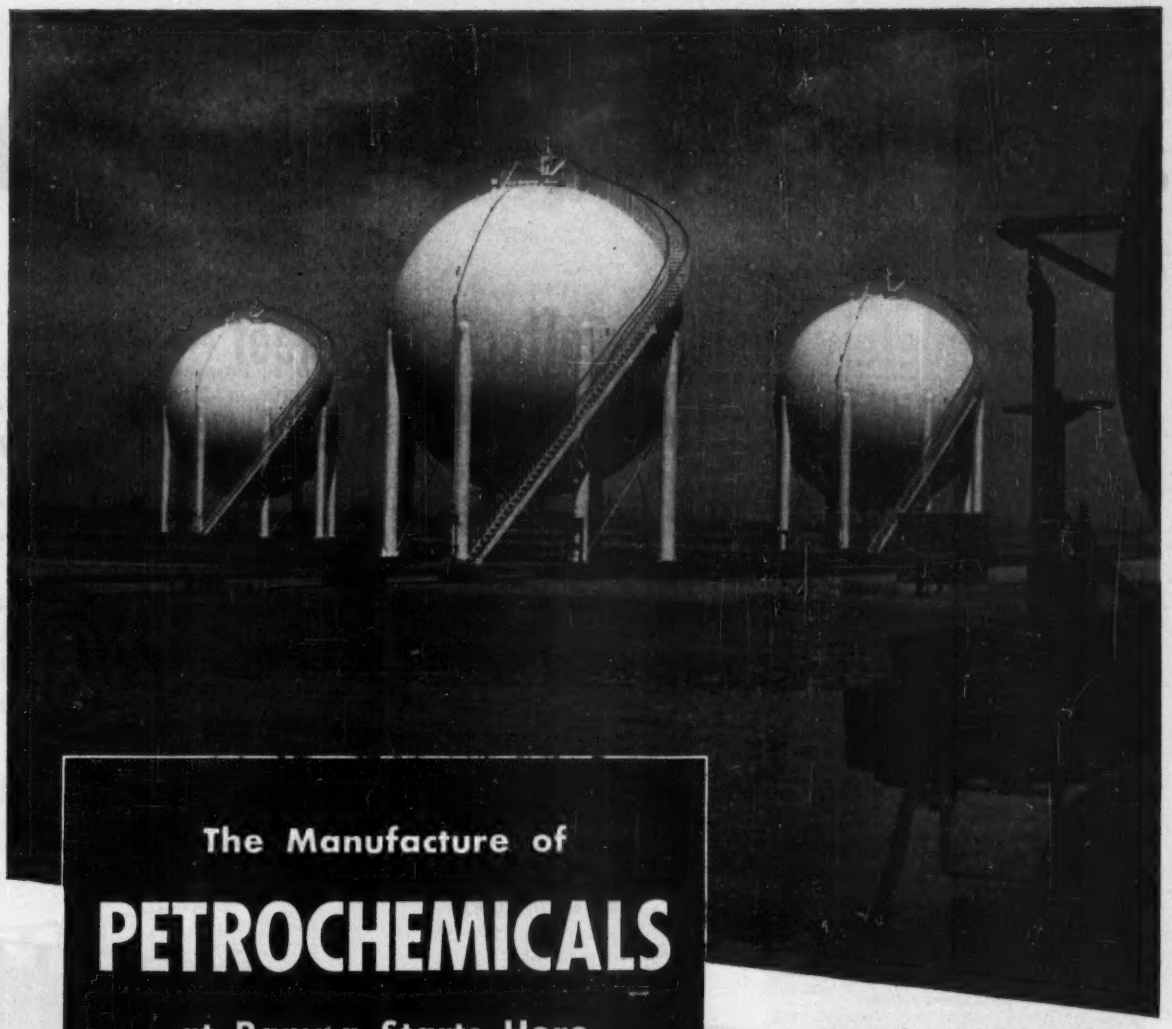
You can specify TRENTWELD for your tubing needs with confidence, too. And nowhere can you get a wider selection. TRENT produces the largest assortment of stainless and high-alloy tubing in the industry... from ⅛" to 40" O.D.

For your tubing applications, remember — *you can't buy better tubing than* TRENTWELD.

TRENTWELD

STAINLESS STEEL TUBING

TRENT TUBE COMPANY, GENERAL SALES OFFICES, EAST TROY, WISCONSIN (Subsidiary of CRUCIBLE STEEL COMPANY OF AMERICA)



The Manufacture of

PETROCHEMICALS

at Pampa Starts Here

Hortonspheres installed at Celanese Corporation of America's new plant at Pampa, Texas. They are 40-ft. 6 in. in diam. and are built for a 75 lb. per sq. in. working pressure.

These three Hortonspheres* were installed to provide pressure storage for liquified butane and propane gases at Celanese Corporation of America's new petrochemical plant at Pampa, Texas. The liquified gases, stored in the Hortonspheres until needed for processing, serve as raw material for a number of important commercial chemicals.

When in need of pressure storage vessels, chemical storage tanks, elevated water tanks or special welded steel plate work, write our nearest office for estimates or quotations. There is no obligation on your part.

** Trade Mark Registered in U.S. Patent Office*

CHICAGO BRIDGE & IRON COMPANY

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Cleveland 15.....2220 Midland Bldg.
Detroit 26.....1503 Lafayette Bldg.
Havana.....402 Abreu Bldg.
Houston 2.....2103 C & I Bldg.
Los Angeles 17..1505 General Petroleum Bldg.
New York 6.....3318—165 Broadway Bldg.
Philadelphia 3...1625—1700 Walnut St. Bldg.
Pittsburgh 19.....3205 Alcoa Bldg.
San Francisco 4.....1522—200 Bush St.
Seattle 1.....1305 Henry Bldg.
Tulsa 3.....1623 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNSYLVANIA

Announcing Foster Wheeler's new

completely tooled to effectively meet your most exacting needs for steam generators, heat-transfer and process equipment!

1. 8000 TON BEAM PRESS
Hydraulically operated, will bend steel plates 40' long, 8" thick.

2. PLATE EDGE PLANER
Will take the longest available plates, for cutting welding grooves.

3. OVERHEAD CRANES
Four large cranes capable of lifting the heaviest and largest equipment easily.

4. DOUBLE HOUSING PLANER
Highest speed planing.

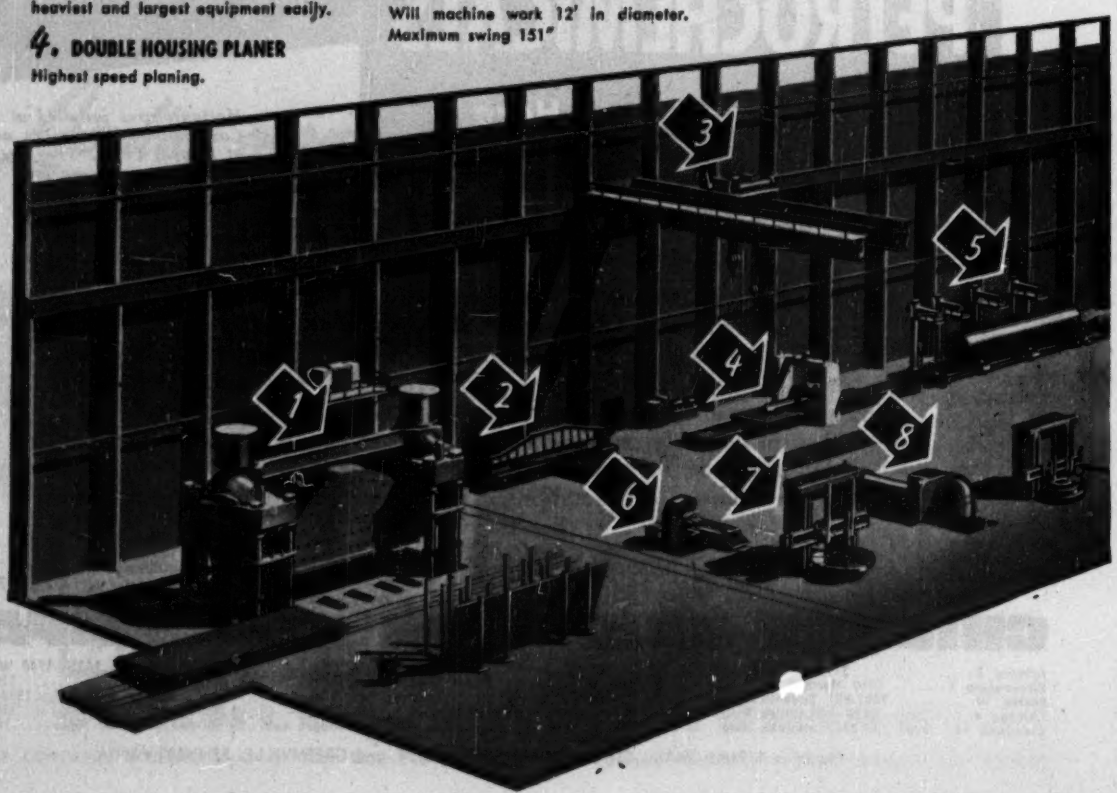
5. AUTOMATIC WELDING MACHINES
Submerged-arc, automatic flux recovery-type, mounted on track.

6. 500 TON CRIMPING PRESS
For cold-bending edge of plate preparatory to rolling.

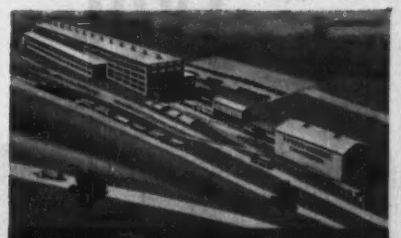
7. VERTICAL BORING MILL
Will machine work 12' in diameter. Maximum swing 151"

8. BENDING ROLLS—PINCH TYPE
By hot or cold rolling will form cylinders for medium-pressure vessels.

9. HIGHEST SPEED DRILLS—RADIAL TYPE
These are mounted on ways and tracks, power positioned.



Mountain Top plant...



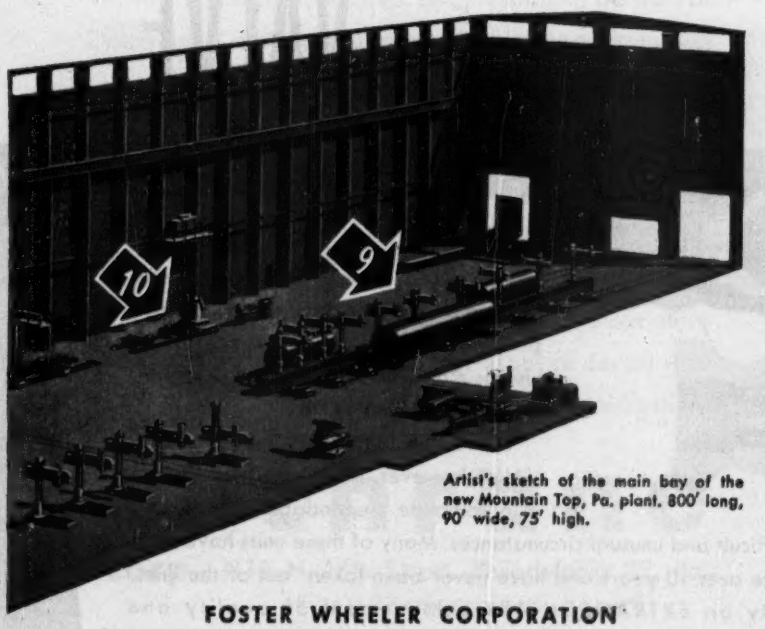
Artist's drawing of Foster Wheeler's new Mountain Top plant near Wilkes-Barre, Pa.

ANTICIPATING your requirements for more efficient central station, industrial and process components, Foster Wheeler has installed in this new plant, near Wilkes-Barre, Pa., the latest, most modern equipment, such as: the 8000-ton beam press, 2 million volt x-ray facilities, the newest developments in submerged arc-welding and high-speed drilling equipment, 83½ foot long stress-relieving furnace and others shown here.

This modern equipment, plus the plant's proximity to steel supplies, and its strategic location for direct rail shipment to all areas of the country, assure you of fast, economical, high-quality fabrication to meet your specifications for the largest and heaviest drums and pressure vessels.

2,000,000 volt x-ray facilities enable operators to see through 12 inches of steel.

10. **DRUM FACING MACHINE**
Quick preparation of ends of cylinder for assembly with heads.



Artist's sketch of the main bay of the new Mountain Top, Pa. plant. 800' long, 90' wide, 75' high.

Stress relieving furnace permits annealing of fabricated parts more than 83 ft. long.

Shot blast building is equipped for surface cleaning by latest practice.

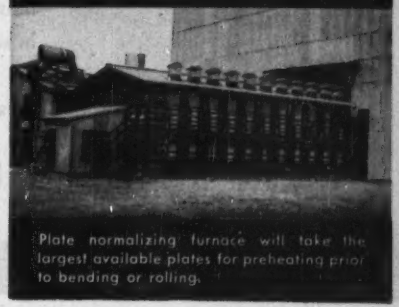


Plate normalizing furnace will take the largest available plates for preheating prior to bending or rolling.

FOSTER WHEELER CORPORATION

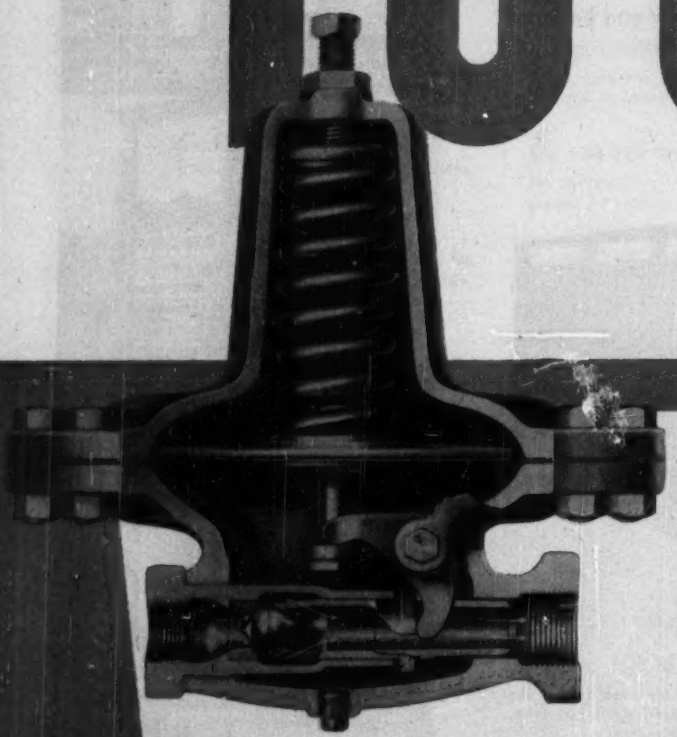
Designers and Constructors of

Stationary and Marine Steam Generators and Condensers
Process Equipment • Chemical and Petroleum Plants

NEW YORK • LONDON • PARIS • ST. CATHERINES, ONTARIO

FOSTER WHEELER

* TYPE 1000 VALVE



Any product of quality should be dependable when *ordinary* products fail. Sudden pressure fluctuations, dirt, scale and viscous matter prove "fatal" to ordinary pressure reducing valves.

The CASH STANDARD TYPE 1000 VALVE however, is designed to operate with complete dependability under the most difficult and unusual circumstances. Many of these units have been in service over 10 years and have never been taken "out of the line."

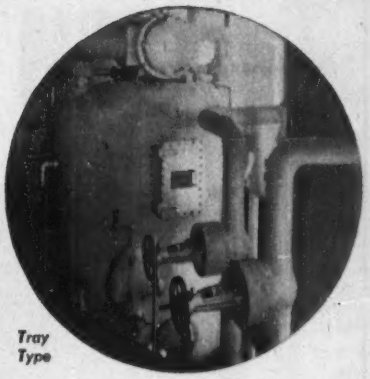
Truly an *EXTRAORDINARY* achievement of quality and design excellence.

*** INSTALL CASH STANDARD "TYPE 1000" VALVES**

CASH STANDARD **DECATUR, ILLINOI**

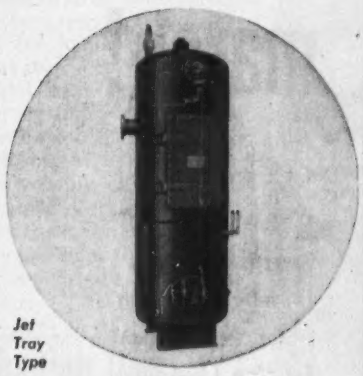
A. W. CASH COMPANY

DEAERATOR TYPES FOR ALL SERVICE REQUIREMENTS

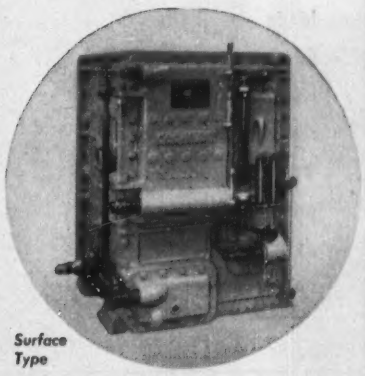


Tray Type

Atomizer or Spray Type



Jet Tray Type



Surface Type

HAVE YOU PROBLEMS OF: CORROSION? FEED WATER HEATING? DEAERATION?

Call Cochrane. Whether your plant is large or small, the *unbiased* recommendations of Cochrane Engineers will assure the correct selection of equipment for your particular operating conditions. As specialists in the field of Deaeration, Cochrane originated the jet tray and atomizing principles and designs and manufactures all types of Deaerating equipment—Tray, Jet Tray, Atomizer or Spray, and Surface—in all sizes, all materials.

Over 90 years of specialized experience in water conditioning are at your service when you call a Cochrane Engineer. Write for the address of our office nearest you. We'll be happy to discuss your requirements without obligation.

COCHRANE CORPORATION WATER ENGINEERS FOR 90 YEARS 1863 - 1953

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In Cuba: Laurence E. Daniel, Inc., Havana
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Hot Process Softeners • Deaerators • Dealkalizers • Demineralizers • Reactors • Continuous Blow-Off • Specialties • C-B Systems

to the rear march!

For further data on advertised products . . . For information with a profit-making slant . . . For New Literature . . . New Bulletins . . . New Ideas . . . Editorial Reprints . . . turn to Readers' Service section at the back of this issue. Valuable information will promptly be sent to you direct from the manufacturer.

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TEMPERATURE INDICATORS

- Precision-built indicators provide accurate temperature readings.
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- Send for new catalog, describing many thermometer styles.

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INSTRUMENT AND GAUGE DIVISION
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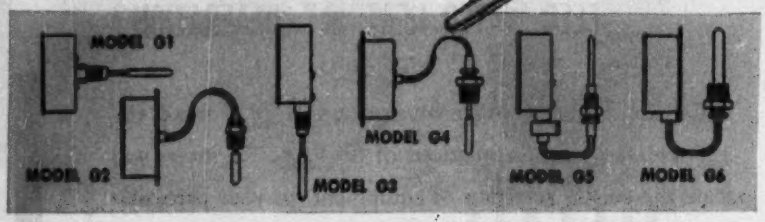
MODEL "S"
Select the type that is best for your purpose. 3½" dial; evenly calibrated scales. From $18.



Automatic Valve Operation With No Electrical Power!

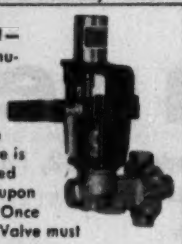
NEW! ASCO® Pressure Operated Manual Reset Valves

Reduce Hazards! Provide Reliable Operation!

MOVEMENT	PIPE SIZES (Inches)	Maximum PRESSURES (lbs./sq. in.)
2 Way*	⅜-6	600
3 Way	¼-½	300
4 Way	¼-¾	250

*Normally open or normally closed

OPERATION—Valve is manually set and remains in operating position until pressure is lost or applied (depending upon Valve type). Once tripped, the Valve must be manually reset.



APPLICATIONS—Bulletin 8035 Valves are ideal for remotely controlled, safety shut-off applications where it is not desirable to depend upon electrical power for operation. Valves are *pressure operated*, thus:

A. eliminating explosive hazards encountered with electrical operation.
B. assuring completely reliable operation where electricity is undependable or non-existing.

AVAILABILITY—Two types:
(1) Trip on pressure failure.
(2) Trip on pressure application.

Standard Valves are constructed of bronze, cast-iron, steel, and stainless steel. Other materials are available if required. Valves can be provided with auxiliary switches for indicating lights or electrical control circuits.

ASCO lists hundreds of standard valve types and maintains an engineering service for special designs. We manufacture a complete line of Electromagnetic Controls, including Automatic Transfer Switches, Remote Control Switches, Contactors, Relays, and Complete Control Panels.

Write for Free Literature!

ASCO Electro-Magnetic CONTROLS ASCO Electro-Magnetic CONTROLS

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381 LAKESIDE AVENUE • ORANGE, NEW JERSEY

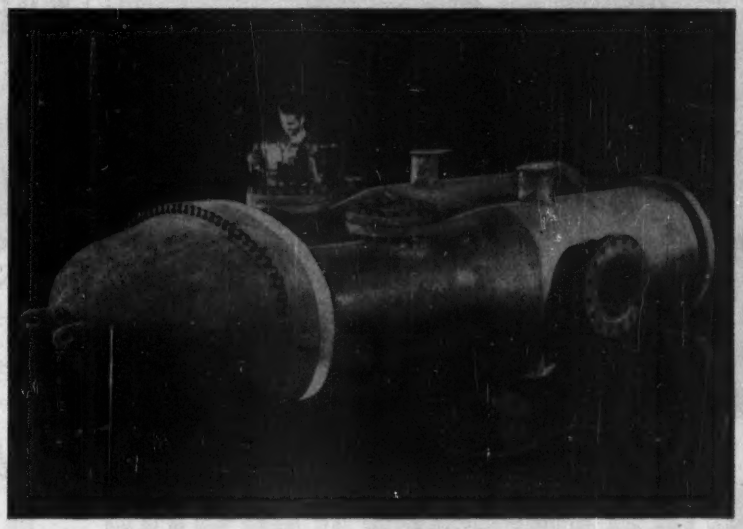
PROCESS EQUIPMENT NEWS

PUBLISHED BY FABRICATED PRODUCTS DIVISION, THE M. W. KELLOGG COMPANY · DECEMBER 1953

Unique Bundle Puller Makes Gains Abroad

Kellogg's Hydro-Ejector, a special device for hydraulically removing and retracting tube bundles, is now standard equipment in many refineries. The use in the United States has generated considerable interest abroad, and independents as well as U. S. affiliates are using this portable unit to speed maintenance work.

Experience has proved that two men can handle even the largest bundles, taking less than 25 minutes to perform the operation of ejecting or retracting any size unit a distance of eight feet. The Hydro-Ejector can exert a force of 12,000 pounds, sufficient to overcome dirt formations that cause many bundles to stick.



Special High-Temperature Exchangers for Gasoline-from-Coal Synthesis

Illustrated is one of ten unique heat exchangers especially designed and fabricated by Kellogg for use in a gasoline-from-coal synthesis plant under construction in South Africa. This exchanger is being made ready for hydrostatic testing.

When in service the units will perform a highly critical function in the pre-heating of gas in a catalytic reforming unit. Each capable of operating under temperatures of 1625°F and pressures of 365 psi, the exchangers are being fabricated in Kellogg's shops rather than overseas because of Kellogg's extensive engineering and fabrication experience in production of alloy equipment for handling critically high temperatures and pressures.

Tubes and tube sheets of the exchangers are fabricated of Type 310 stainless steel. The shells are internally insulated.

In the reforming unit, residual hydrocarbons in synthesis gas, produced in the coal gasification plant, and recycle gas from the synthesis section are converted to additional synthesis gas.

High-Pressure Units Scheduled for Chemical Plant

Four special high-pressure exchangers for a major chemical processor are now being designed in Kellogg's heat transfer division.

They are of the integral tube sheet-channel type because of the operating pressures which will be in the neighborhood of 1000 psi on the tube side. Each will contain a U-tube bundle consisting of 32-foot long copper tubes.

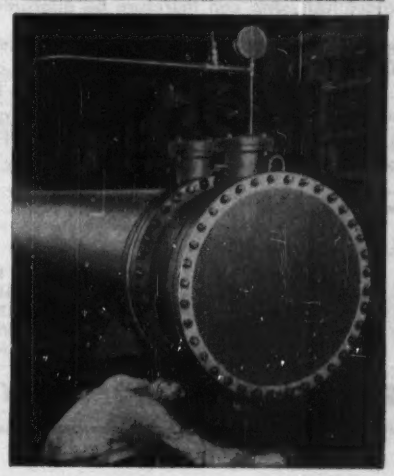
FABRICATED PRODUCTS DIVISION OF M. W. KELLOGG COMPANY

KELLOGG PULLMAN

Reflux Exchanger for Combination Unit

This reflux-crude exchanger is one of many exchangers, coolers and condensers recently completed in the shops for a combination refinery in Brazil. Here it is shown undergoing hydrostatic testing.

The unit is 35" inside diameter, of steel construction throughout, using ¾"OD tubes on square spacing. When installed the unit will preheat crude against reflux gas oil raising its temperature from 60° to 280°F.



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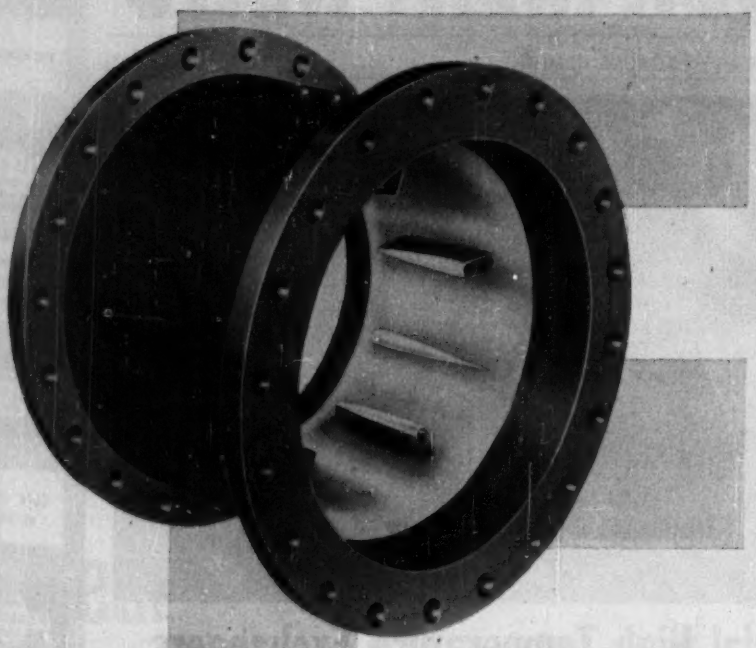

CHOOSE A FLOW TUBE

Flow Tubes offer economies all through their long service lives.

First cost is low. Installation costs are low, too, because Flow Tubes can be installed inside the plant. They are short, compact, and require only minimum straight runs entering and following. No expensive vaults are needed.

Operating costs are low. They require little, if any, maintenance. Pumping costs are low because Flow Tubes are available in types and D/d ratios to handle a wide range of fluids and main line velocities. This enables you to use the one Flow Tube that will produce differentials that can be accurately measured, with the least head loss.

All Flow Tubes are furnished with head capacity curves obtained in laboratory tests, and can therefore be guaranteed as to accuracy.

That's why Flow Tubes are being successfully used in scores of installations metering the flow of liquids and wet or dry gases. Available in all pipe sizes and suitable metals. They can be furnished with or without suitable secondary indicating, recording or totalizing instruments. For further information, write for your Flow Tube Data File. For specific recommendations, send us necessary flow data.

FOSTER AUTOMATIC VALVES

PRESSURE REGULATORS • RELIEF AND BACK PRESSURE VALVES • CUSHION CHECK VALVES • FAN ENGINE REGULATORS • PUMP GOVERNORS • TEMPERATURE REGULATORS • FLOAT AND LEVER BALANCED VALVES • NON-RETURN VALVES • VACUUM REGULATORS OR BREAKERS • STRAINERS • SIRENS • SAFETY VALVES • FLOW TUBES

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for HEAT or PROCESS

Economical, and highly efficient, **SUPERIOR Steam Generators** arrive at your plant ready to produce steam for process or heat. Completely factory assembled and tested, they are backed by undivided responsibility.

- Fully automatic burning oil or gas or both in combination.
- Mounted on rigid channel iron base, they require no special foundation.
- Built-in induced draft eliminates the need of an expensive chimney.
- Simple installation permits a nearby source of process steam.
- Battery installation provides extreme flexibility for varying steam demands.
- Special units for permanent outdoor installation.
- Fire-Tube models in 18 sizes from 20 to 600 b.h.p. for pressures up to 250 p.s.i. Write for catalog 522-F.
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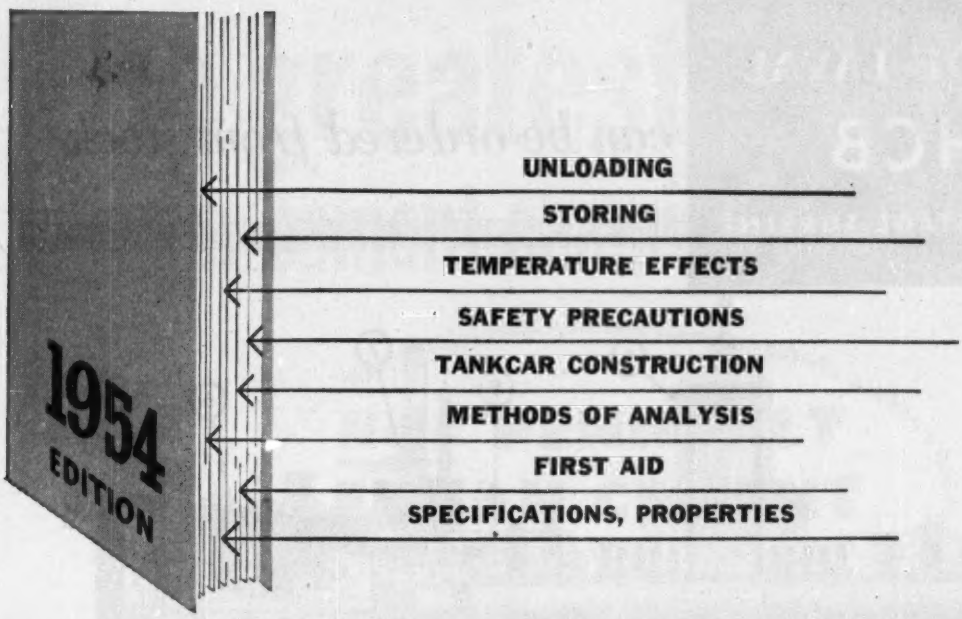

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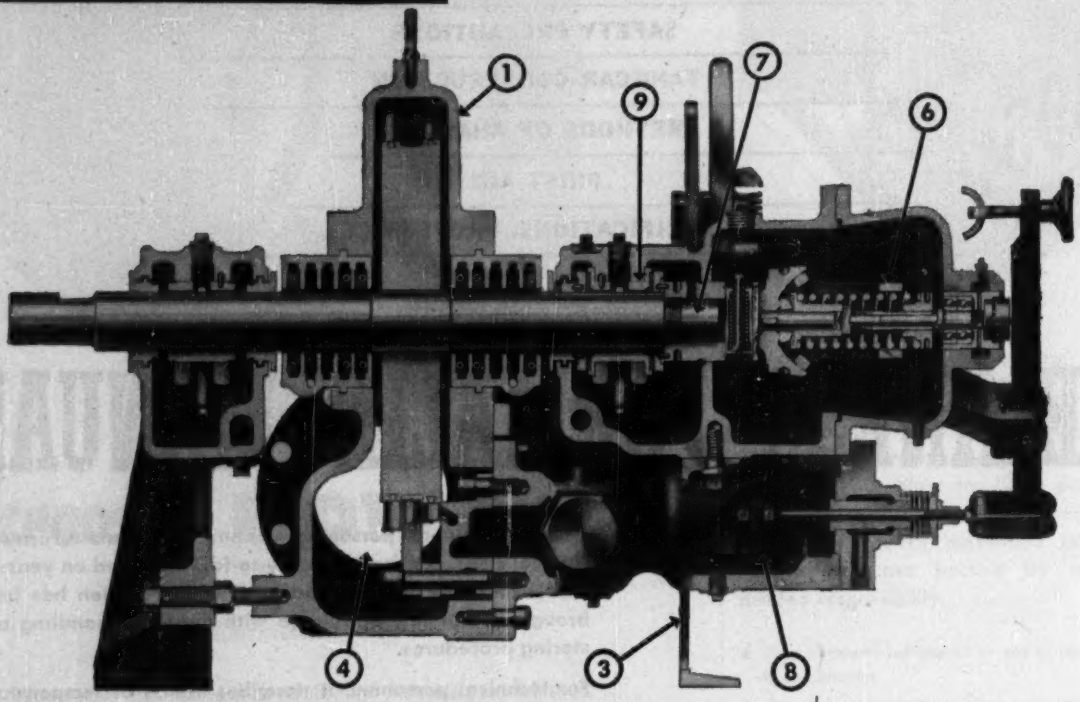

1 Case and Cover Split Horizontally on centerline for ease of maintenance.

2 True Centerline Casing Support assures distortion-free radial expansion. *Not shown.*

3 Flexible Support at governor end provides for axial expansion.

4 Exhaust Opening either right or left side for installation flexibility.

5 Steam Strainer, protecting trip and governor valves, is removable for cleaning without breaking steam connections. *Not shown.*

6 Constant Speed Governor features governor weights pivoted around frictionless surfaces.

7 Complete Governor Assembly is now *replaceable as a unit.*

8 Balanced Single Seated Main Governor Valve has proportional flow characteristics for sensitive, positive control.

9 Shaft Locating Bearing of adjustable double collar type.

Horsepower: 100 MAX
Steam Pressure: 300 PSIG MAX
Steam Temperature: 550F MAX
Exhaust Pressure: 25 PSIG MAX
Speed: 4,000 RPM MAX
Steam Inlet: 2"–250# ASA FLG.
Exhaust: 6"–150# ASA FLG.
Weight: 1,200 LB.

Here's the new De Laval HCB Single Stage Turbine which is now "on the shelf" . . . ready for immediate shipment. This mechanical drive turbine is simple, rugged, designed for long economical life and low maintenance. For example, note the true centerline casing support, the replaceable governor, the removable steam strainer. Investigate all the advantages of this versatile driver. It is ready to handle—*at low cost*—a variety of applications in your plant.

Send for new Bulletin 4206
which gives vital facts and figures

DE LAVAL *Mechanical Drive Turbines*

DE LAVAL STEAM TURBINE COMPANY
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OL809

The greatest advance in resin-cement chemistry in ten years

New PENNSALT FURAN CEMENT

A Fura-Tone® Product

manufactured under Pat. Nos. 2,461,510 & 2,600,764

Combines *all* the advantages of ordinary furan-type cements with many *new* ones —*yet costs no more!*

Now Pennsalt, original producer of quick-setting silicates and resin-type cements, offers an entirely new and exclusive furan cement—far superior to anything on the market today! It supersedes other products as the most versatile, general-purpose cement for bonding acid-proof brick or tile in the construction of corrosion-resistant linings, floors, and trenches.

The new Pennsalt Furan Cement is based on a furfural-ketone resin, completely different from furfural-alcohol types now in common use. It has all the important virtues of other furan cements as well as many it alone can claim (see list at right).

Perhaps the most startling fact about new Pennsalt Furan Cement is this: even considering its many advantages, it costs no more than ordinary furan cements now on the market! To give speedy service to customers, Pennsalt is stocking this new product at many points throughout the nation.

Pennsalt Corrosion Engineers are ready to advise users on the proper application of new Pennsalt Furan Cement. For further information about this outstanding product or its use, just write: Corrosion Engineering Dept., Pennsylvania Salt Manufacturing Co., 455 Widener Bldg., Philadelphia 7, Pa.

Properties of new Pennsalt Furan Cement

The important advantages common to furan cements:

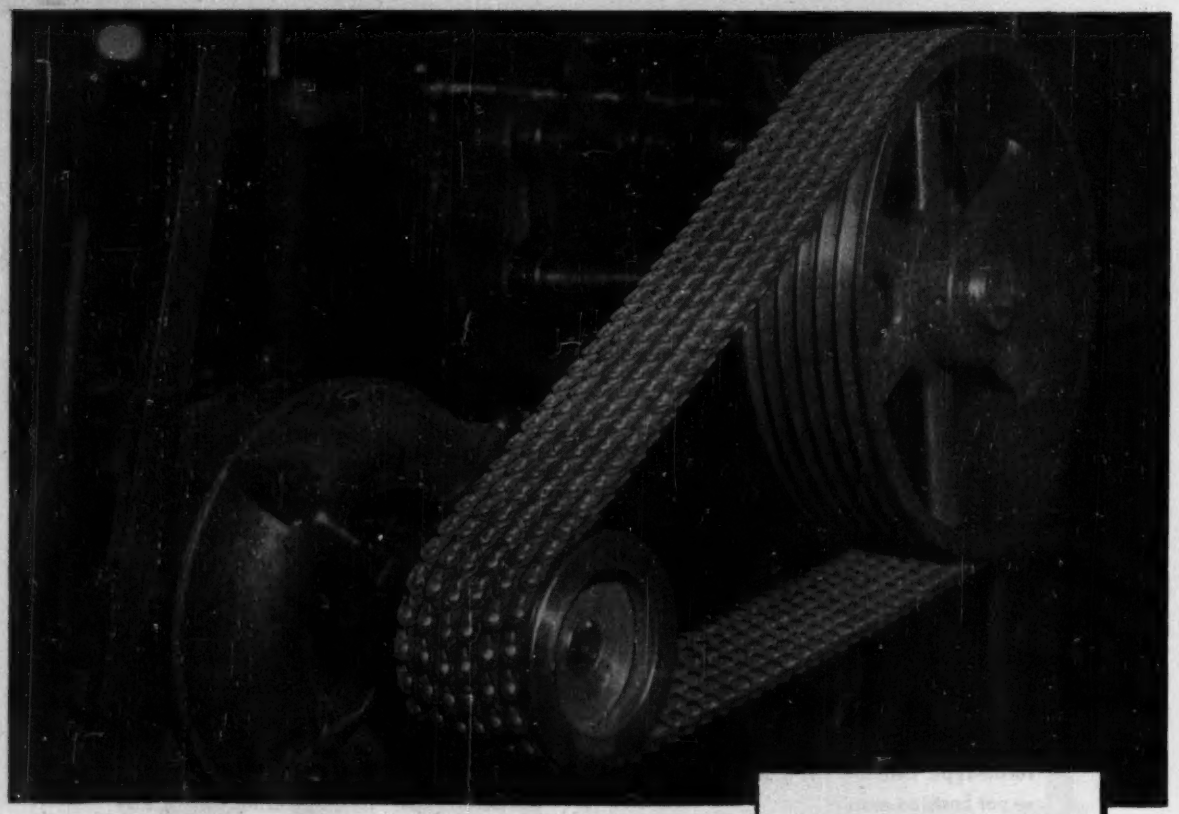
1. Stable—store it indefinitely
2. Does not cause dermatitis

Plus all these points of clear superiority:

3. Actual, workable 2-to-1 powder-solution ratio
4. Increased acid resistance
5. Increased alkali resistance
6. Increased resistance to most solvents
7. Longer working life
8. Easier handling characteristics—less "temperamental" or "hot"
9. Choice of powders—Powder C (carbon filler) and Powder S (siliceous filler)
10. Economical to buy and use

Pennsalt Chemicals

Fura-Tone is a Trademark of Irvington Varnish & Insulator Division of Minnesota Mining & Manufacturing Company



with Veelos on your machines...

v-belt adjustment is a production-saving job

All v-belts stretch—but with endless v-belts there's nothing you can do to take up this stretch once the motor has been completely "run-out". With Veelos it's another story! The adjustment is in the belt itself—even sliding motor bases are unnecessary.

Changing the length of each Veelos v-belt by just adding or removing links is the best, most efficient, way to keep the belts correctly matched. Using Veelos means that the job of adjustment is done easily and quickly . . . at a fraction of the cost of replacing with new belts.

Veelos, the adjustable v-belt, provides vibrationless, full power delivery. It is easier to stock and control because it is packaged on 100-foot reels in every standard width. And Veelos can be adjusted or made up in correctly matched sets with the least amount of machine down-time—at production-saving speed!

Have you seen this Veelos Facts Book?

Your Veelos v-belt distributor's salesman will be glad to give you a quick trip through this fact-packed, 36 page book. You'll find it well worth the few minutes it takes. Next time the salesman calls, ask him to show it to you.

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THE LINK
V-BELT

Write today for your copy of the Veelos Data Book—it is a completely illustrated, 28-page catalog that gives file-worthy product and engineering facts which you should have handy. We'll be glad to send you a copy at once.

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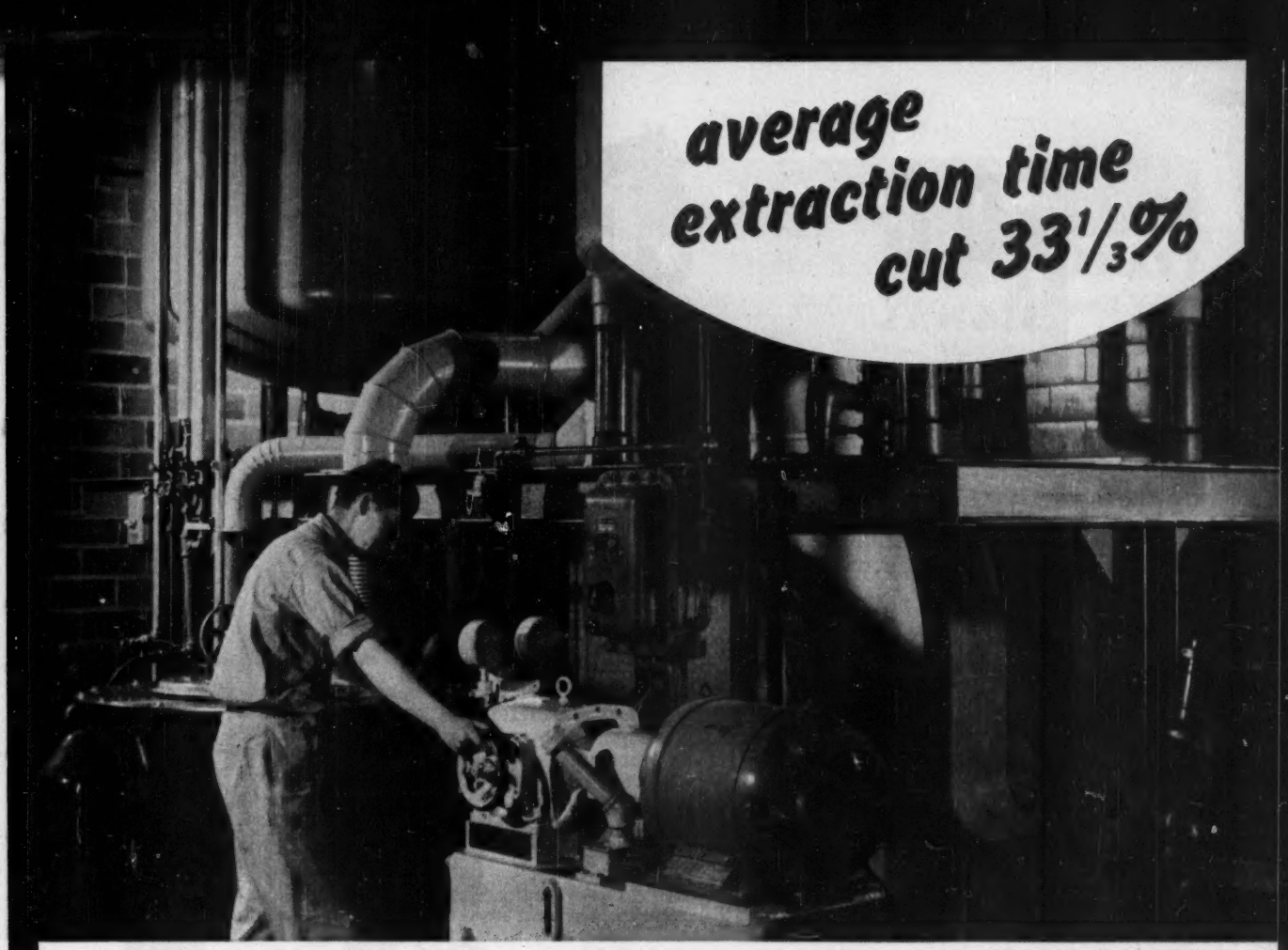
602 Manheim Street, Manheim, Penna.

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE



Once more the ANY-SPEED Oilgear Drive betters machine performance "painlessly"

Many times in our experience the performance of an already highly efficient machine has been bettered without redesign, solely by changing the drive. One case out of many *varied* cases, is the Tolhurst Centrifugal pictured above, located in a great pharmaceutical house. This centrifugal was originally equipped with a two-speed electric motor drive. However the chemicals it is called upon to handle have widely varying crystal packing characteristics. Some of these crystals packed so densely at the speed available, extraction was inhibited, extraction time far out of balance and crystal removal difficult.

A change was made to an *"ANY-SPEED"* Oilgear Fluid Power Drive. Now the operator is able to shade the speed of the centrifuge experimentally—*and easily discover* the *best* speed for each batch of crystals.

As a result, extracting that used to take from 6 to 9 hours was cut to 4 to 6 hours. The extremely slow speed also available made unloading a great deal easier. This user now has several other Oilgear drives including one on a laboratory centrifuge.

There is very often a direct efficiency coefficient between machine operating speed and the type of work being handled. And we can cite many widely varying instances where equally dramatic and profitable gains resulted at once from a simple change to *"ANY-SPEED"* Oilgear Fluid Power Drives. If you want some interesting factual data on Oilgear's steplessly variable speed drives, their outstanding responsiveness to control impulses, their smooth acceleration and deceleration, talk to an Oilgear Engineering Representative. His mature and sound engineering recommendations may profit you greatly. THE OILGEAR COMPANY, 1579 W. Pierce St., Milwaukee 4, Wisconsin.

OILGEAR

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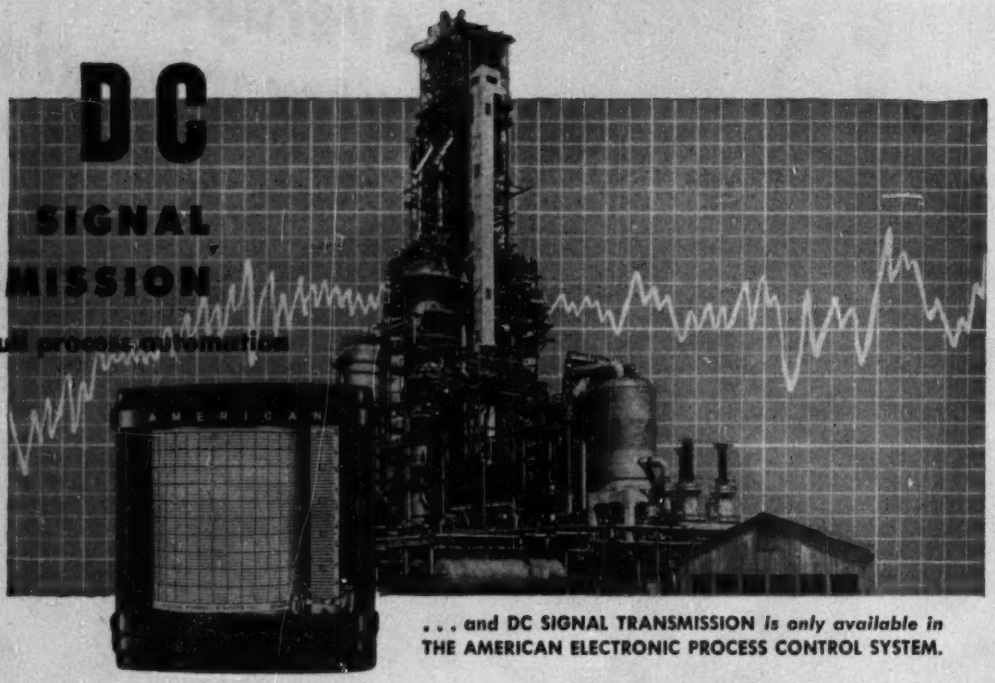
DC SIGNAL TRANSMISSION

the key to full process automation



. . . and DC SIGNAL TRANSMISSION *is only available in* THE AMERICAN ELECTRONIC PROCESS CONTROL SYSTEM.

Most modern electronic print-out, monitoring and computing equipment is designed for DC operation. Until recently it was impractical to integrate these automatic devices with instruments that measure process variables. Consequently, complete process automation was impossible.

Now—the new American Electronic Process Control System provides the major compatability factor essential to achieve the economic advantages of full process automation: *DC signal transmission.*

The instantaneous DC transmission of process variable measurements permits higher controller gains that result in a new concept of control performance. At the same time, it makes possible the efficient "electric nerve center" so essential to the low-cost operation of the ultra modern plant of today and the standard plant of the future. In short, the American Electronic Process Control System provides the only practical foundation for integration of . . .

1. **AUTOMATIC LOGGING** — the continual listing of operational data in tabulated digital form.
2. **AUTOMATIC MONITORING** — the centralized supervision of all measured criteria for maximum safety and efficiency.
3. **AUTOMATIC COMPUTING** — for precise accounting and engineering analysis at highest speed and lowest cost. Ushers in the fully automatic plant with completely automatic product analysis and control.

In addition to this unique versatility, the American Electronic Process Control System offers *improved quality of control* — tighter control that opens the way for a reduction in the size of process equipment and consequently a lower capital investment for a given through-put. Furthermore — *simplified communication* — with two-wire DC signal transmission lines that are unaffected by induced alternating currents and varying line resistance, the cost and complexity of present systems will be vastly reduced.

When you select process control equipment, basic considerations are performance, initial installed cost, reliability, maintenance, and flexibility. The advanced design and operation of all instruments in the American Electronic Process Control System assure complete satisfaction on every count. Convince yourself. *Write for Catalog No. 164.*

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A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

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WHAT *HE* THINKS OF YOUR TANKS?
(A POSEY IRON Bid Might Interest Him and YOU)

Most treasurers are apt to put cost first. And cost is certainly *not* the only factor to consider when buying steel plate construction.

But —

It's good engineering as well as good financial policy to refuse to pay a penny more for tanks . . . or pressure vessels . . . or stacks . . . than is necessary fully to meet *the standard desired.*

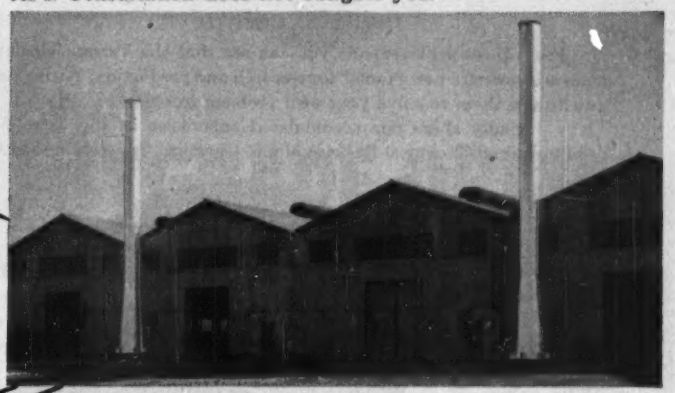
The Posey Iron Works offers you 42 years of money-saving experience over the full range of steel plate fabrication . . . *practical* engineering and design service that concentrates on structural integrity and safety rather than on cost-padding "frills".

That's why we say a Posey Iron bid might interest your treasurer as well as you.

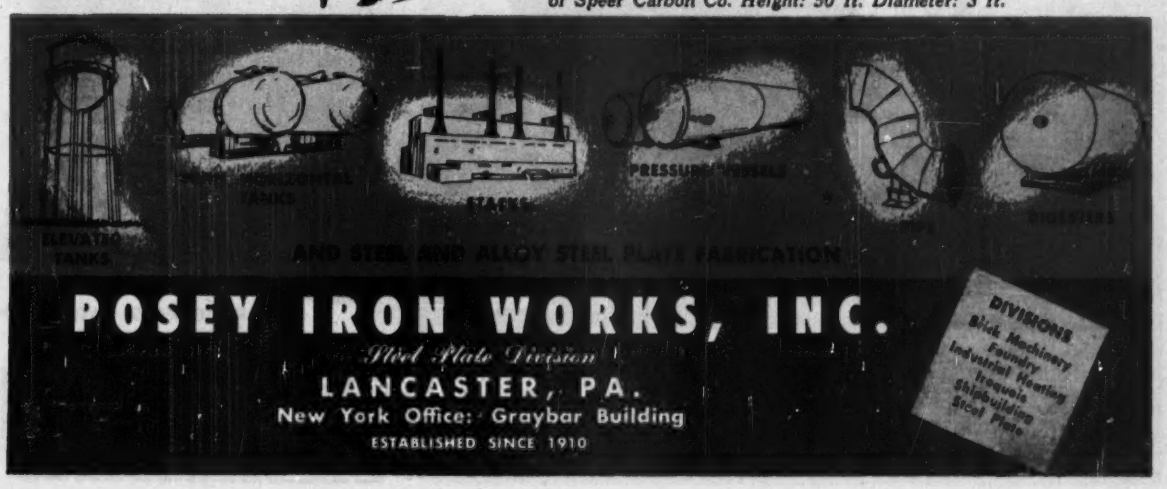
Edges of Plates Properly Prepared for Welding . . .
Electrodes Carefully Selected

Perhaps more than any other production step, welding influences tank costs and structural soundness. Every electric welder in Posey's shops is fully qualified. No plate is welded without proper preparation of edges . . . electrodes are chosen after careful consideration of requirements.

Posey meets all standard codes including ASME; API-ASME; API. Consultation does not obligate you.



Posey Iron Works self-supporting stacks installed at the Niagara Falls Plant of the International Graphite & Electrode Division of Speer Carbon Co. Height: 50 ft. Diameter: 3 ft.



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For more than a quarter-century we have devoted all of our time, talent and energies to the study of chelate chemistry. From this has resulted the origin, development and production of the Versene Chelating Agents. We manufacture no other products and have no other interests. Chelation and chelation alone is our business. It is the only world we know.

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Our specialization in this particular kind of chemistry now makes it possible for you to use chelation to solve problems created by the presence of metal ions in solution. Proof of its effectiveness may be found in all fields of science. In Agriculture, for instance, it cures iron chlorosis (deficiency) to the point where growth is stimulated, yield increased and maturation speeded. In Medicine, it stabilizes whole blood, decontaminates both internally and externally by removal of radioactive deposits, cures acute lead and other heavy metal poisoning, purifies and stabilizes drugs and pharmaceuticals, solubilizes "insolubles" in animal, human and mechanical circulatory systems. In Industry, it separates rare metals, controls polymerization of cold rubber and plastics, prevents or removes metallic stains and contamination in processing of textiles, papers, dyestuffs, foods, beverages, etc., increases detergency of soaps and synthetics, softens water completely and permanently without formation of precipitates.

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From these achievements you can see that the Versene Chelating Agents are powerful new "tools" for research and production. We invite you to use them to solve your own problem in chelation. We will gladly share our accumulated experience in this field. Send for samples and Technical Bulletin No. 2. Chemical Counsel on request.

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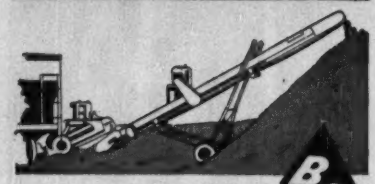

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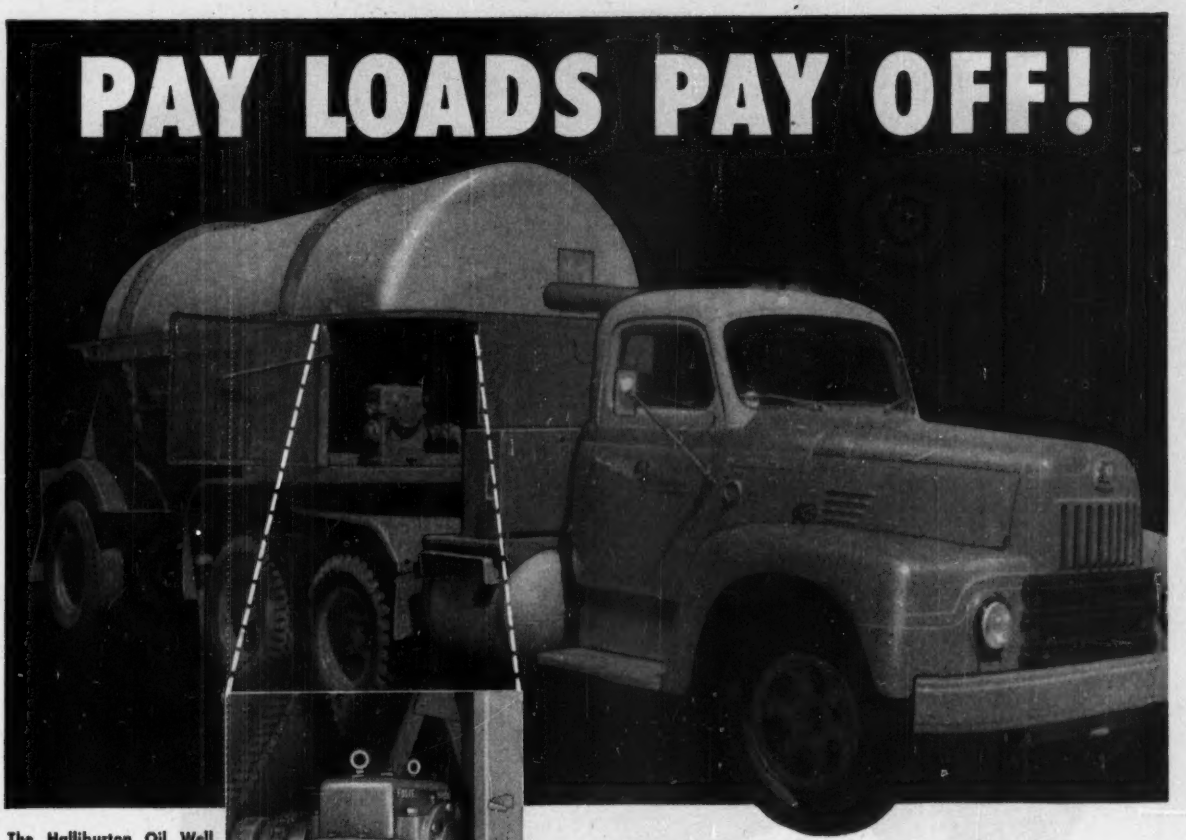

The Halliburton Oil Well Cementing Co., Duncan, Okla., keeps cement at right consistency during travel by using specially-designed Rotovoy trucks. Power is transmitted as desired through rugged Hygrade Drives.

with HYGRADE DRIVES

Install 'em in your plant — even mount 'em on your trucks — *wherever* tough jobs call for rugged, space-saving drives — the Foote Bros. Hygrade line can solve your problem.

Hygrade worm gearing is skillfully engineered — precision generated — assures you greater efficiency, maximum power. Sturdy construction, improved design, compact housings — all offer you the savings on maintenance, the superior performance you've been looking for.

Hygrade Drives are available with horizontal or vertical output shafts — vertical extending upward, downward or both. Vertical Hytop units incorporate a wider, low-speed bearing span to accommodate long, unsupported extensions. Single, helical and double-worm reductions provide you with ratios up to 4,108 to 1—capacities to 260 h.p.

For better drives for every job, see your Foote Bros. representative, or write for helpful information.

This Trademark Stands for the Finest in Industrial Gearing

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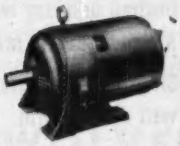
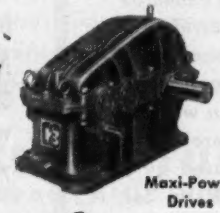


Foote Bros.-Louis Allis Gearmotors



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It's the Nash!

The ability of Nash Compressors to maintain original performance over long periods is no accident. Nash Compressors have but a single moving element, the Nash Rotor. This rotor is precision balanced for long bearing life, and it revolves in the pump casing without metallic contact. Internal lubrication, frequent cause of gas contamination, is not employed in a Nash. Yet, these simple pumps maintain 75 lbs. pressure in a single stage, and afford capacities to 6 million cu. ft. per day in a single compact structure.

Nash Compressors have no valves, gears, pistons, sliding vanes or other enemies of long life. Compression is secured by an entirely different principle of operation, which offers important advantages often the answer to gas handling problems difficult with ordinary equipment.

Nash Compressors are compact and save space. They run without vibration, and compression is without pulsation. Because there are no internal wearing parts, maintenance is low. Service is assured by a nation-wide network of Engineering Service offices. Write for bulletins now.

- No internal wearing parts.
- No valves, pistons, or vanes.
- No internal lubrication.
- Low maintenance cost.
- Saves floor space.
- Desired delivery temperature Automatically maintained.
- Slugs of liquid entering pump will do no harm.
- 75 pounds in a single stage.

NASH ENGINEERING COMPANY
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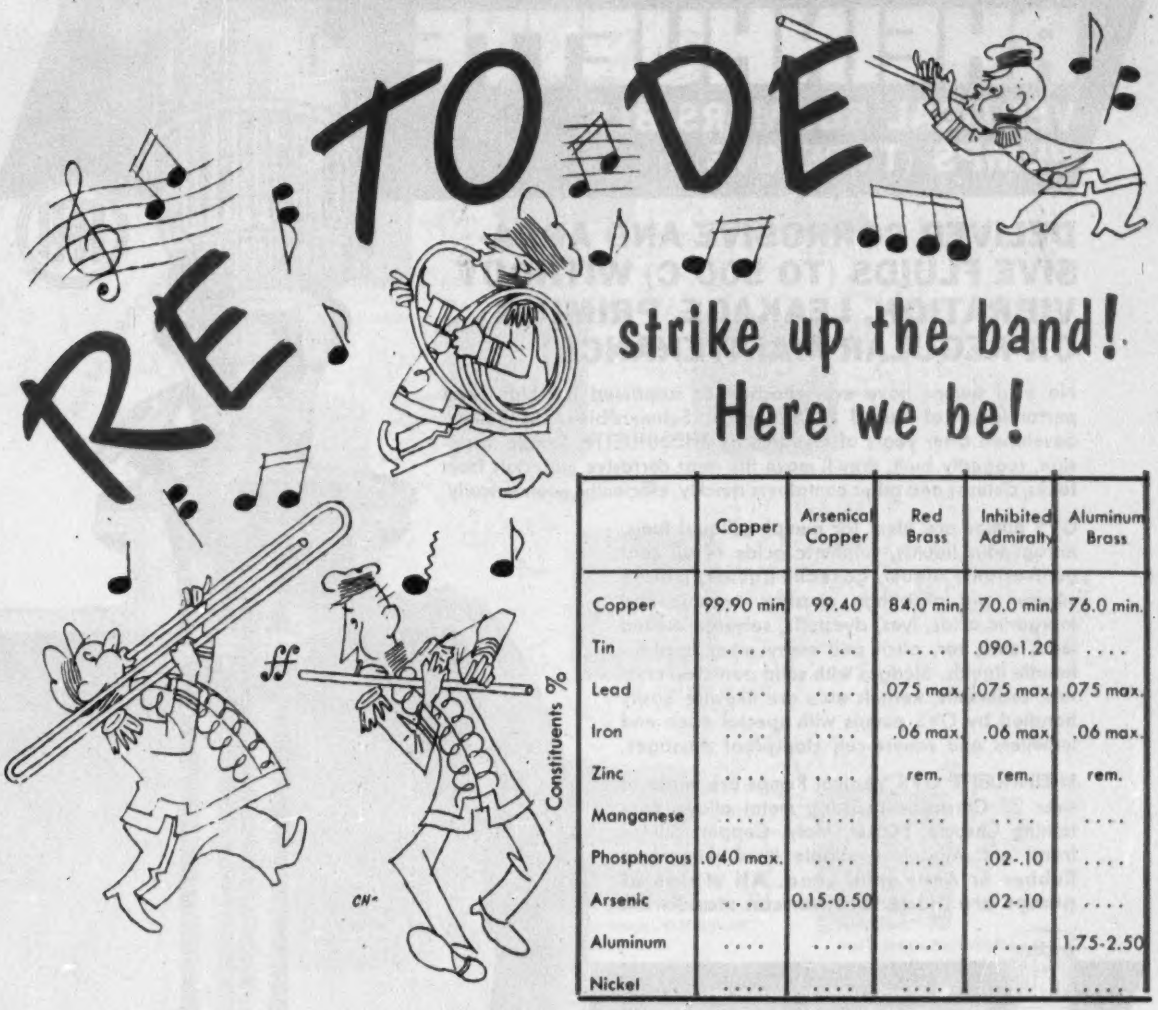

Constituents %	Copper	Arsenical Copper	Red Brass	Inhibited Admiralty	Aluminum Brass
Copper	99.90 min.	99.40	84.0 min.	70.0 min.	76.0 min.
Tin	....	....	....	.090-1.20	....
Lead	....	....	.075 max.	.075 max.	.075 max.
Iron	....	....	.06 max.	.06 max.	.06 max.
Zinc	....	....	rem.	rem.	rem.
Manganese	....	....	....	....	....
Phosphorous	.040 max.	....	....	.02-.10	....
Arsenic	....	0.15-0.50	....	.02-.10	....
Aluminum	....	....	....	....	1.75-2.50
Nickel	....	....	....	....	....

RE . . . TO DE . . . . . READY TO DELIVER

Adding the missing letters (indicated by dots) you make the entire line read:

Ready to deliver to you the condenser tubing you require in any of the alloys and popular sizes shown on the chart above.

You'll want to specify Wolverine condenser tubing because its entire manufacture is subjected to more controls than most any other tubing. Every possible attention is paid to wall thickness and lengths, and the tubing undergoes special quality tests before it is released for shipment. Close tolerances, quality testing and special handling (all routine matters with Wolverine) go to make this condenser tubing the outstanding performance-standard in the industry—The tube to specify for dependability . . . Wolverine.

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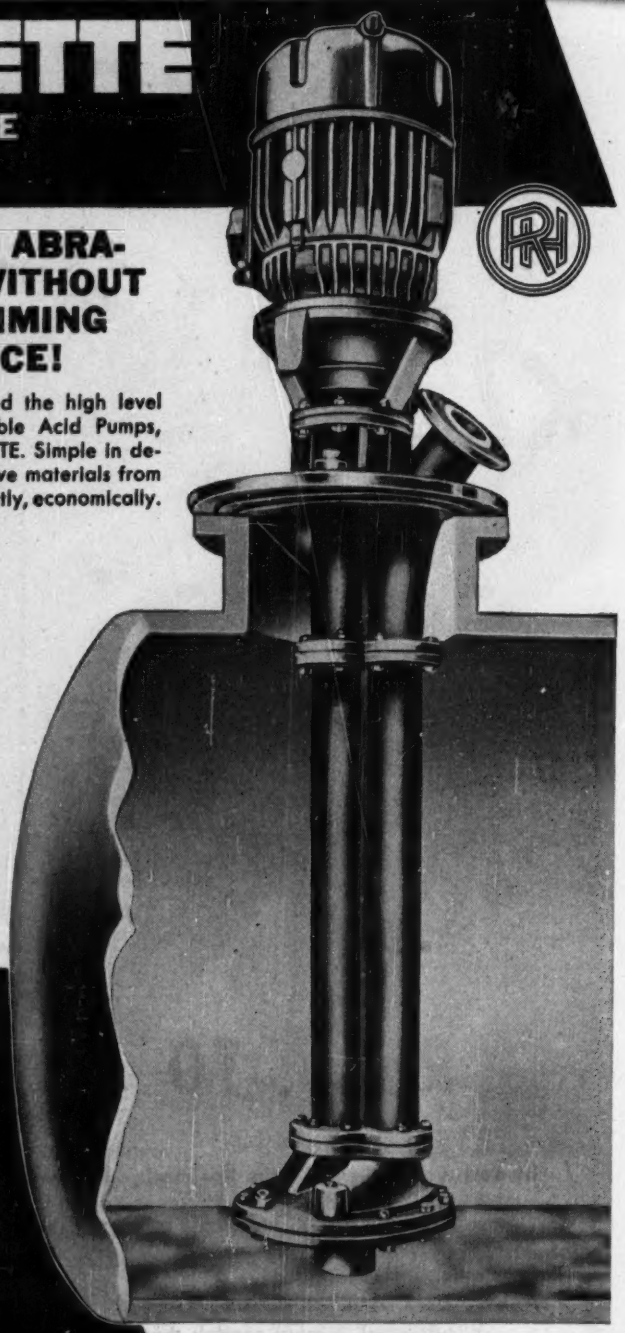
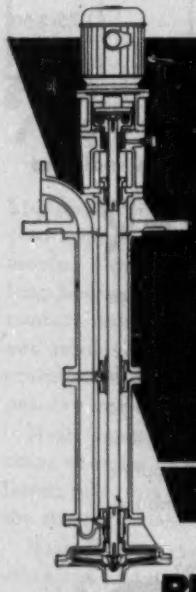


DELIVER CORROSIVE AND ABRASIVE FLUIDS (TO 500°C) WITHOUT VIBRATION, LEAKAGE, PRIMING OR REGULAR MAINTENANCE!

No acid pumps have ever reached or surpassed the high level performance of famed GVS Vertical Submersible Acid Pumps, developed after years of research by RHEINHUETTE. Simple in design, ruggedly built, they'll move the most corrosive materials from tanks, cisterns and other containers quickly, efficiently, economically.

GVS pumps are ideal for pumping liquid fuels, nitrogenous liquids, sulphuric acids of all concentrations, oleum, gaseous liquids, molten sulphur and phosphor, caustics, organic and inorganic acids, lyes, dyestuffs, solvents, melted lead, zinc, tar, pitch and many other hard-to-handle liquids. Sludges with solid particles: crystals, sediments, kernels etc., are likewise easily handled by GVS pumps with special open end impellers and square-cut, clog-proof passages.

RHEINHUETTE GVS Vertical Pumps are made of over 25 Corrosion resisting metal alloys, containing Chrome, Nickel, Moly, Copper, Silicon Irons, etc. Models available lined with Hard Rubber or Antimonial Lead. All styles of pumps are made to American standards.



- always ready to operate because pump head is always immersed in fluid to be pumped. Adaptable to permanent or portable installations.
- no suction line, no foot valve
- no leakage of fluid can reach Stuffing Box. Return feed sends fluid back into original container. Stuffing Box serves only as a gas seal.
- separation of drive shaft from discharge tube within a single casting permits simple flange mounting, eliminates vibration.
- minimum servicing required since motor and motor drive are not submerged in fluid . . . and because pump bearings are constantly lubricated by fluid itself.

ALL RHEINHUETTE PUMPS ARE CUSTOM-BUILT TO YOUR SPECIFIC NEEDS!

OUR COMPLETE LINE INCLUDES:

Centrifugal Acid Pumps without Stuffing Box • Centrifugal Acid Pumps with Relieved Stuffing Box • Self-Priming Acid Pumps • Screw Impeller Acid Pumps • Centrifugal Pumps with Full-Way Tubular Impeller • Acid and Sewage Sump Pumps • Cement Slurry Centrifugal Pumps.

Our engineers and metallurgical experts —some of the world's most experienced —are ready to assist you in the economical, permanent solution of your pumping problems.

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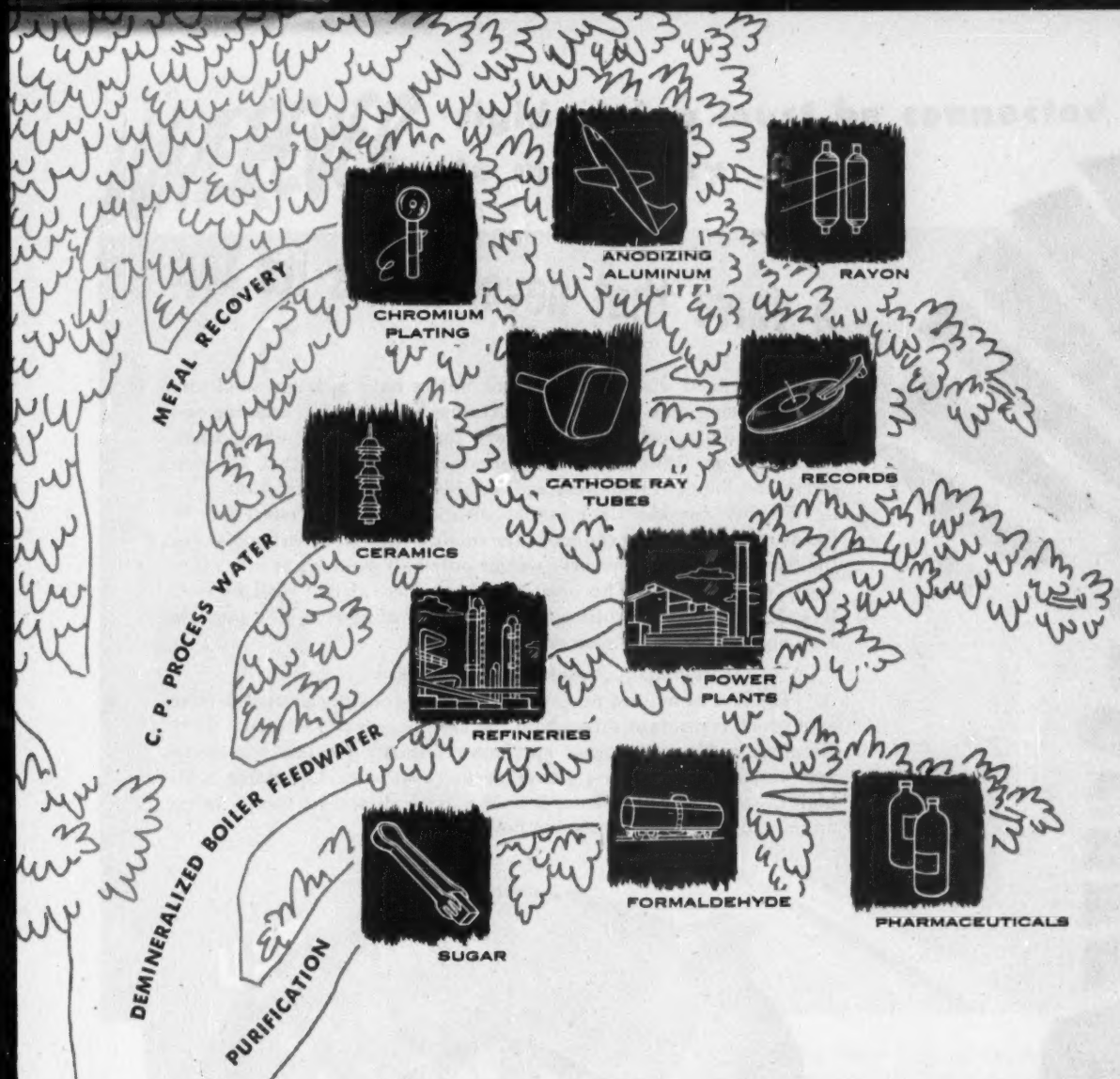


How versatile is ION EXCHANGE?

If you define "versatility" as the ability to do many jobs, ion exchange more than fills your needs.

Shown above are just a few applications of Permutit Ion Exchange resins and equipment. Newer ones are being discovered almost daily. Ideas that solve problems, improve products. And often provide a handsome return by cutting costs or salvaging valuable materials from wastes.

Take chromium plating as an example. An ion exchange process *originated* by Permutit improves the operation in many ways. It demineralizes the rinse water, gives a better finish. It also recovers costly chromic acid from rinse water for re-use. Rinses can then be recycled, saving both water and fuel . . . eliminating waste treatment problems.

In addition, it purifies the baths—which maintain full electrolytic efficiency, last indefinitely. Greatly reduced dumping of the baths ends stream pollution problems.

Perhaps this suggests profitable applications in your business. Your research department may add others. We'll gladly send technical data and resin samples. Write to THE PERMUTIT COMPANY, Dept. CE-12, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

ION EXCHANGE HEADQUARTERS FOR OVER 40 YEARS

PERMUTIT®

a valve that never blows its top

All K & M diaphragm Control Valves have a drawn steel diaphragm casing able to withstand extreme heat, impact, pressure and shock . . . and a cast steel open yoke that retains its strength when the heat is on. When something goes wrong, the difference between safety and danger might very well be this all steel construction.

Further, consider the everyday advantages of the all steel K & M construction: One man can move the smaller size valves without hoists, for the K & M steel topworks weighs only half as much as other topworks of equal size. The open yoke, provided in cast steel by *only* K & M, assures accessibility and completely eliminates any possible accumulation of gas, vapor or condensate.

More linear . . . more accurate . . . more responsive

The K & M molded neoprene diaphragm provides a large effective area which is constant throughout the long stem travel. Thus, K & M Diaphragm Motors provide maximum linearity in stem movement and virtually the highest power factor available. Operating with high capacity, low turbulence K & M valve bodies, these motors mean more accurate, more responsive flow regulation.

For Complete Automatic Control Valve Data: Write for your copy of the new K & M Valve Engineering Data Catalog, Bulletin CV53. *Also Available . . . New Valve Size Calculator with Low Flow Data.*

diaphragm control valves

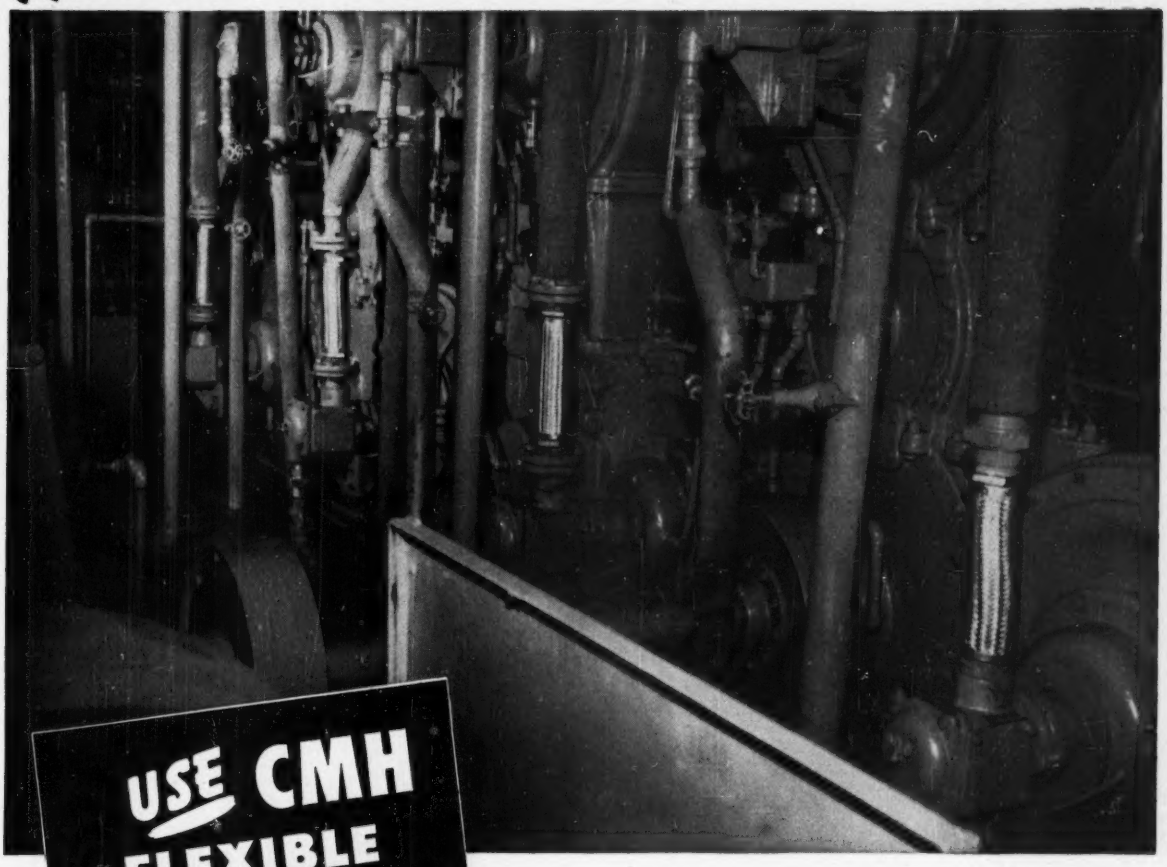
KIELEY & MUELLER, INC.

K&M

Valve Makers Since 1879

64 Genung Street
Middletown, New York

WHEREVER rigid piping must be connected to machinery



USE CMH FLEXIBLE METAL HOSE

YOUR GUIDE TO MOTION CONTROL

Catalog 130 gives specifications for all types of CMH hose. Write for a copy or see the Flexonics catalogs in Chemical Engineering Catalog and Sweets Plant Engineering File.

By using CMH Flexible Metal Hose as the connecting link between rigid pipe and machinery, you solve two otherwise serious problems—the elimination of damage to the piping because of vibration and the compensation for any misalignment that may exist. Properly installed, CMH Flexible Metal Hose will give long, dependable, trouble-free service without further attention.

Whatever your flexible connection problem, there is a CMH hose type to meet your needs. Corrugated and convoluted types are available in a wide variety of designs and in a complete range of sizes. CMH Flexible Metal Hose is offered in steel, bronze, stainless steel and other alloys to fill your requirements. Your Flexonics distributor will give you further data. Look for his name in your classified telephone directory or we will be pleased to send it to you.

CHICAGO METAL HOSE Division

Flexonics Corporation 1317 South Third Avenue, Maywood, Illinois

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies CMH products that have served industry for over 50 years.

CMH

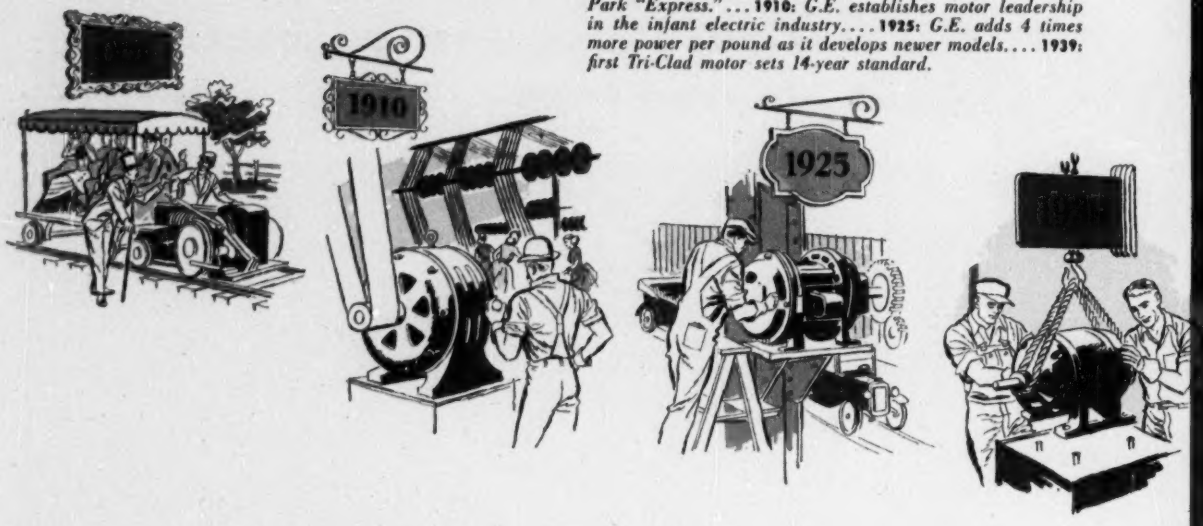
Flexible metal hose

Expansion joints

Aircraft components

Metallic bellows

1878: *Thomas Edison builds an electric motor for his Menlo Park "Express."* ... **1910:** *G.E. establishes motor leadership in the infant electric industry....* **1925:** *G.E. adds 4 times more power per pound as it develops newer models....* **1939:** *first Tri-Clad motor sets 14-year standard.*



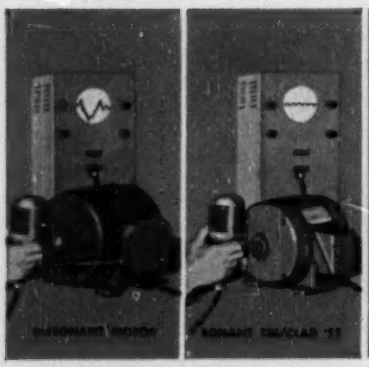
General Electric Announces...

A NEW MILESTONE IN MOTOR HISTORY

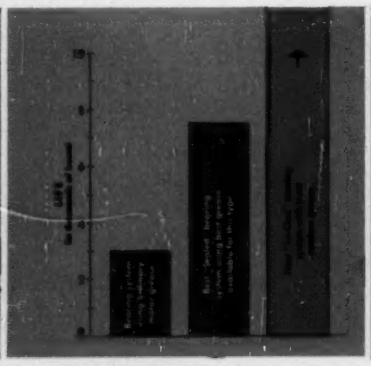
New TRI 55 CLAD motor climaxes 75 years of engineering leadership

The General Electric Tri/Clad '55' is an important milestone in motor history. For this is a *completely new motor*. Born out of thousands of engineering man-hours, the Tri/Clad '55' incorporates design improvements that go far beyond mere modifications. Many years of pure research, the discovery of new, better materials, the knowledge of how to make better use of present materials, and improved manufacturing processes all make the Tri/Clad '55' motor the new leader in the motor field.

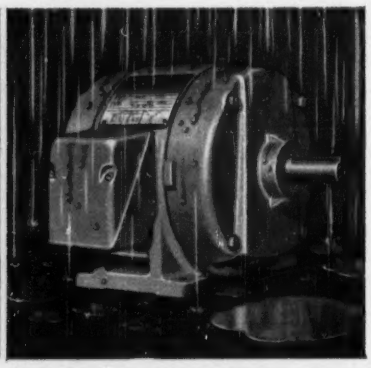
You as a motor user should take the opportunity to see and test this motor for yourself. Contact your nearest G.E. Apparatus Sales Office or G.E. Motor Agent and tell him you want to see the new G-E Tri/Clad '55'. General Electric Company, Schenectady 5, N. Y. 648-4



DESIGNED FOR BETTER PERFORMANCE: Tri/Clad '55' has a low noise level . . . runs cool . . . gives up to 53% increase in shaft output per pound...has higher full-load speeds.



ENGINEERED FOR LESS MAINTENANCE: 10%-life tests (such as the one shown) prove the Tri/Clad '55' bearings last longer without regreasing than any other bearing system.



BUILT TO LAST LONGER: cast-iron strength . . . more fully enclosed dripproof construction . . . water-shedding stator windings . . . polyester film insulation 8 times stronger.

GENERAL ELECTRIC
TRI-CLAD INDUCTION MOTOR
SER. NO.
MODEL
HP
FL RPM
VOLTS
PHASE
CYCLES
FL AMP
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CODE
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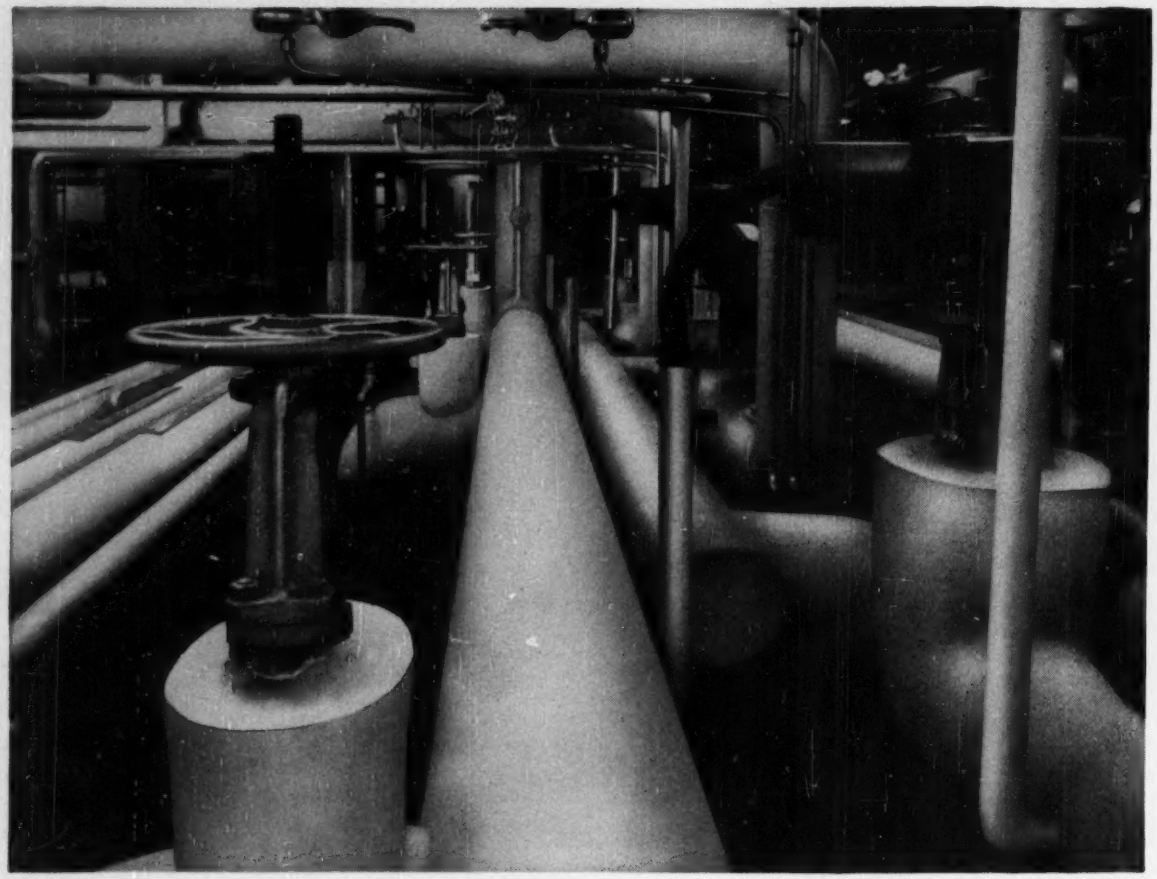
TRI-CLAD
THE LEADER IN MODERN MOTOR DESIGN
Progress is our most important product
GENERAL ELECTRIC



View of Pipe bay in large eastern utility plant, showing pipes insulated with K&M "Featherweight" 85% Magnesia.

FOR ECONOMY'S SAKE

Insulate with "Featherweight" 85% MAGNESIA

Save heat and you save money. Thousands of plants depend upon "Featherweight" 85% Magnesia to do just that. And no wonder!

"Featherweight" needs no introduction to thousands of users, many of whom first experienced its unusual qualities before this century began.

It is a superb insulation, low in thermal conductivity and not only effective on heated surfaces with temperatures up to 600° F., but when used in combination with K&M Hy-Temp Insulation, it is efficient up to 1900° F. This combination of double layers permits staggering all joints and eliminating heat loss through open joints when expansion occurs.

Keep this heat-saving, money-saving insulation in mind for applications in *your* company's plants. It will serve you well—always! For detailed information on "Featherweight" 85% Magnesia, see your local K&M distributor, who is an experienced applicator, or write directly to us.

Nature made asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
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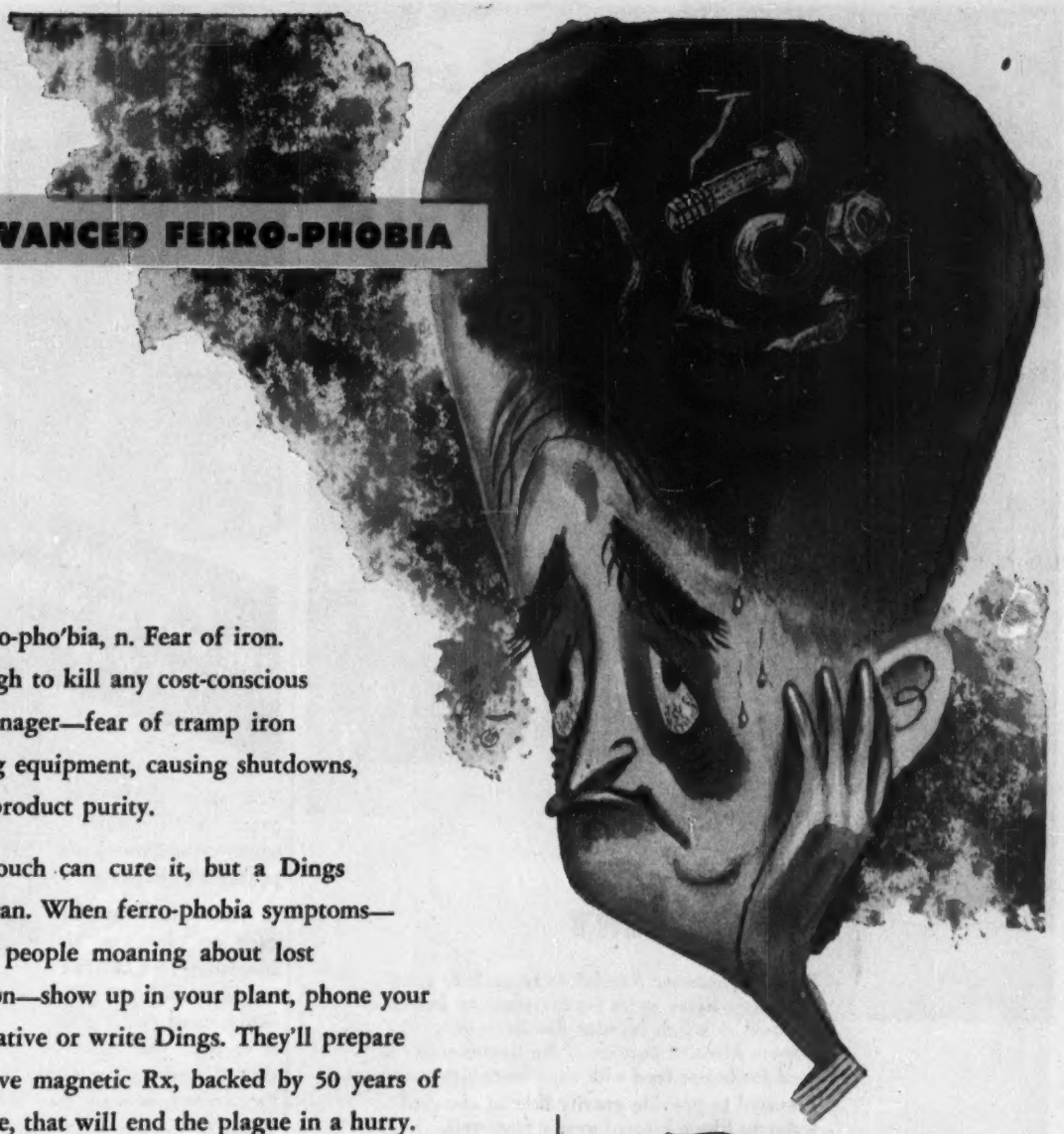
ADVANCED FERRO-PHOBIA



. . . Fer'ro-pho'bia, n. Fear of iron. It's enough to kill any cost-conscious plant manager—fear of tramp iron damaging equipment, causing shutdowns, ruining product purity.

No couch can cure it, but a Dings Magnet can. When ferro-phobia symptoms—unhappy people moaning about lost production—show up in your plant, phone your representative or write Dings. They'll prepare an effective magnetic Rx, backed by 50 years of experience, that will end the plague in a hurry.

We Wiped Out the Plague in Texas—With this "super" 3-stage magnetic hump built for one of the nation's biggest plastic manufacturers. It separates iron contaminated polyethylene pellets from iron-free pellets.

Powerful, non-electric Dings Perma-Plate magnets stop iron in the hump, chutes or ducts. Magnetic strength guaranteed forever.

Dings

DINGS MAGNETIC SEPARATOR COMPANY
4730 West Electric Avenue
Milwaukee 46, Wisconsin

DINGS MAGNETIC SEPARATOR COMPANY
4730 West Electric Avenue
Milwaukee 46, Wisconsin

Please send me Catalog C-1205-B on Dings Perma-Plate Magnets and Catalog C-5000-B with data on the complete Dings line.

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PP453

2 Accelators®

DO A BIG JOB IN A SMALL SPACE!

in a South American **DISTILLERY**

Two 44′ diameter Accelators treat 2800 gpm of Parana River water for clarification and color removal at a San Nicolas distillery in Buenos Aires. A portion of the treated water is used for boiler feed with supplementary treatment.

Elevated to provide gravity flow of clarified water to filters located over a clearwell, these Accelators provide water supply in a fraction of the space required by other types of water treating equipment.

Learn how the Accelator can solve your water treatment problem in *less* space at *lower* cost. Send for informative, illustrated bulletin (see coupon below).

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INFILCO INC. ▌ *Tucson, Arizona*

Plants in Chicago & Joliet, Illinois

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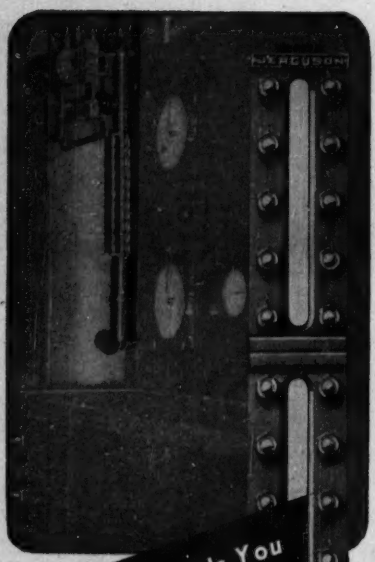

Jerguson Builds You THE KIND OF GAGES YOU WANT

Jerguson Transparent Gage

You can get the kind of gages YOU WANT when you take your gage problems to Jerguson.

If you want a special gage or valve, or an adaptation of some standard one for a particular need, we'll give it to you. Our technically trained engineers have the ability, the know-how and the WILLINGNESS to pitch in and help you solve your problems.

Standard gages and valves, of course, are available at Jerguson's in the most complete and varied line offered anywhere.

Chemicals that raise havoc with ordinary gages can be handled with Jerguson special material and lined gages.

Write us about your problems or requirements.

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Gages and Valves for the Observation of Liquids and Levels

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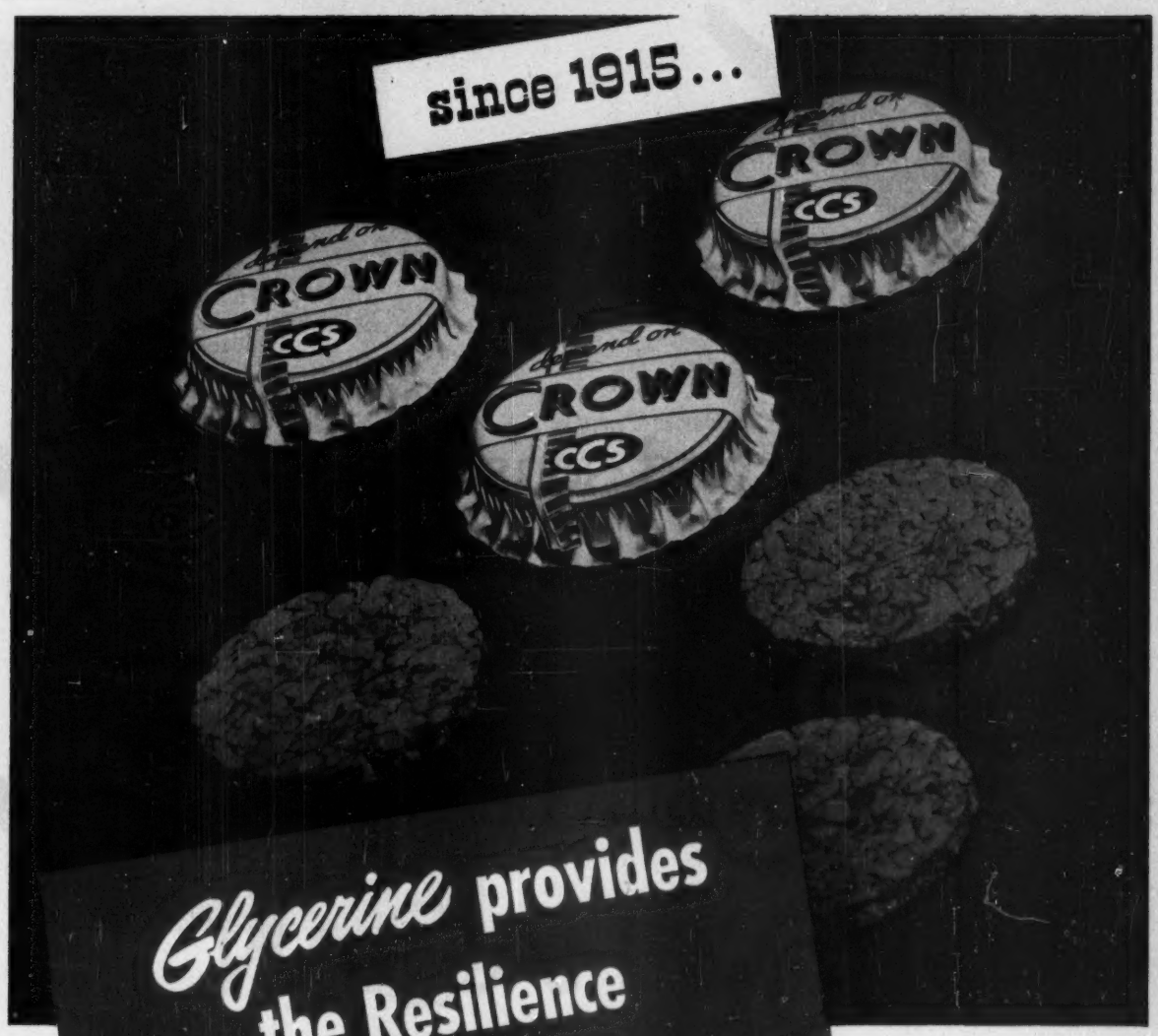

Crown Cork & Seal Company Inc., originators and world's largest makers of crown corks, have used Glycerine for nearly 40 years. Glycerine helps to keep the binder in the cork discs supple, assuring a dependable seal and trouble-free bottling.

Two properties make Glycerine a natural for use in Crown Cork & Seal's composition cork discs. Glycerine helps keep the discs resilient, so that they provide a tight, long-lasting seal.

What is equally important, Glycerine is non-toxic. It is accepted by medical associations and government agencies as safe for use in contact with foods.

Indeed, U. S. P. Glycerine is an important *ingredient* in many confections, flavoring agents, and other food products. Versatile Glycerine can serve as a sweetener, solvent, or blending agent. Its high viscosity imparts smoothness to mixtures, prevents graining.

A handy 16-page booklet, "Why Glycerine for Foods?" reviews Glycerine's unique range of properties and applications. For your copy, write Glycerine Producers' Association, 295 Madison Avenue, New York 17, N. Y.

Nothing takes the place of Glycerine

check the

dollars and sense reasons

for using HAGAN

automatic combustion controls

and HAGAN

ring balance flow meters

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It makes good sense to invest your dollars in Hagan Combustion Controls and Hagan Meters. The investment pays real dividends in the following ways:

accuracy

Hagan Automatic Controls and Ring Balance Meters are accurate, whether the system is simple or complex. This accuracy is reflected in savings which, during the life of the boiler, usually amount to many times the cost of the equipment.

dependability

Hagan Controls and Ring Balance Meters are dependable in their performance, year after year. Long life and low maintenance costs are inherent in all designs.

versatility

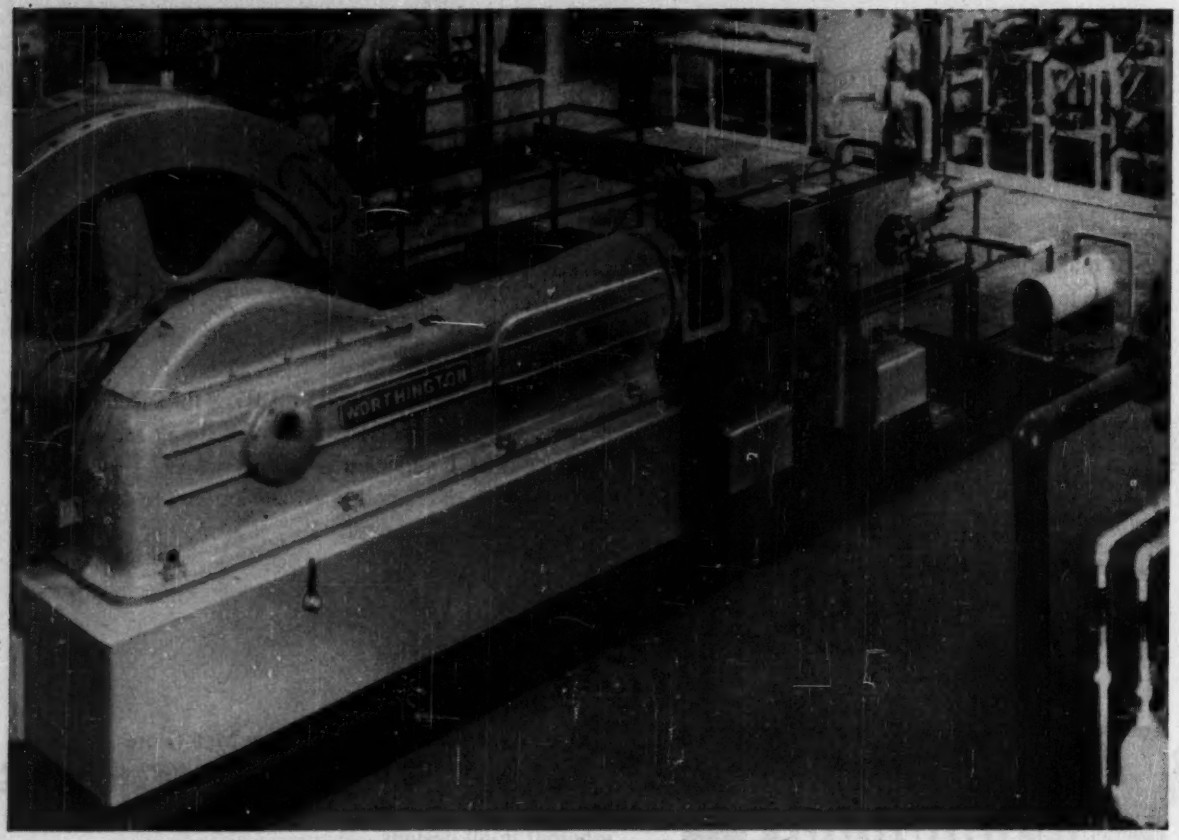
One boiler or many, one or more fuels, Hagan Controls handle the job easily. Hagan Ring Balance Flow Meters are the most versatile meters available for measuring and recording flow of liquids and gases.

Whatever your metering or combustion control problems, let Hagan Engineers help you solve them. Our experience is at your service. Write, or call us, at

HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
CONTROL SYSTEMS FOR AUTOMOTIVE AND
AERONAUTICAL TESTING FACILITIES



HIGH-PRESSURE WORTHINGTON RECIRCULATOR-COMPRESSORS help to manufacture synthetic ammonia at the Hooker Electrochemical Company in Tacoma, Washington. Gaseous nitrogen and hydrogen are compressed, circulated through a catalyst, and converted under maintained pressure and temperature into synthetic ammonia. The Chemical Construction Corporation of New York engineered this installation.

Hooker uses efficient Worthington unit in NH_3 synthesis

The Hooker Electrochemical Company in Tacoma needed a recirculator-compressor that would operate dependably and efficiently at the extremely high pressures involved in the manufacture of synthetic ammonia.

Worthington answered this need by supplying a Worthington High-pressure Recirculator-Compressor, with a discharge pressure of over 5000 psig. This was a routine operation for Worthington engineers, since they have furnished similar units on many previous occasions.

The compressor cylinder, complete with packing boxes, is a one-piece forging. The piston rod, piston and tail rod are also integrally forged. These features insure the accurate alignment essential to successful operation of high pressure equipment. And this alignment is maintained throughout years of operation.

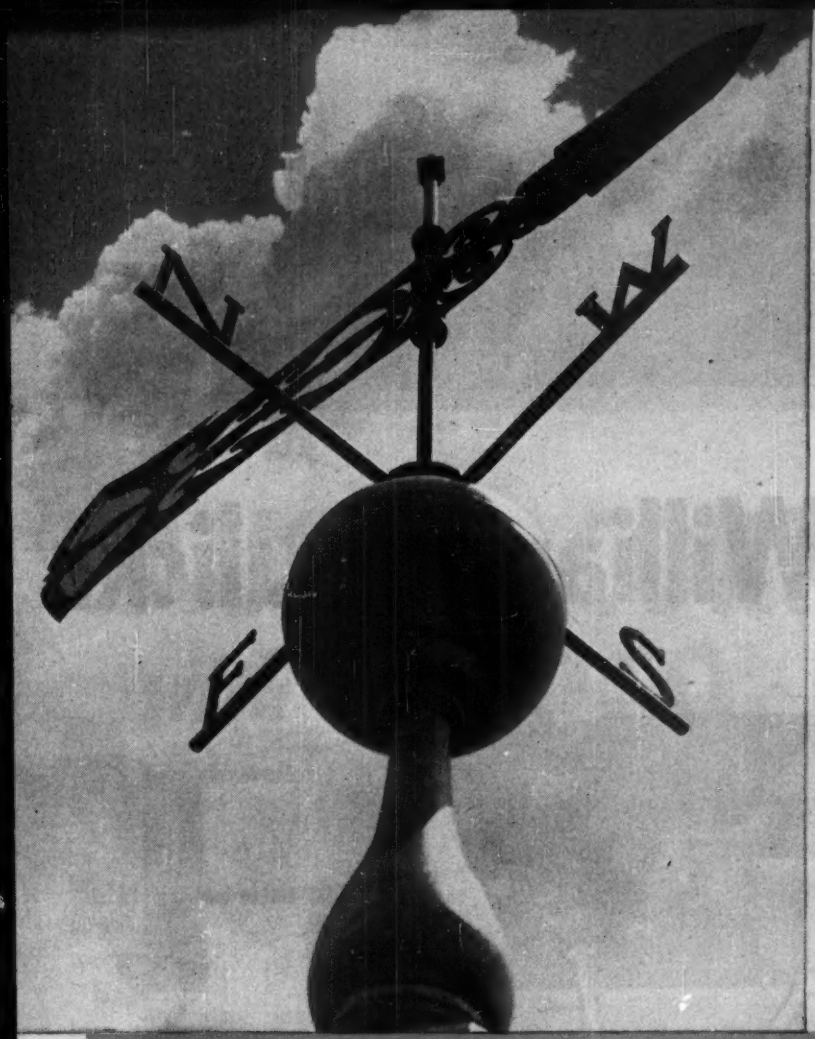
This is another example of the way a manufacturer benefits by Worthington's skilled application engineering and the completeness of the Worthington line. Because Worthington manufactures compressors of every size and type, there's a Worthington machine that will exactly fit *your* needs. Get in touch with your nearest Worthington district office, or write to Worthington Corporation, Compressor Division, Section K.3.2, Buffalo 5, N. Y.

K.3.2

WORTHINGTON

Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors



A Four-Way Selection

This photograph of a weather vane seems a good way to point out the fact that there are four different types of Midwest Welding Elbows (see below). These are more types than are manufactured by any other company. This greater selection is important to users of welded piping because it gives the engineer greater latitude in piping design and permits improvements and economies not otherwise possible in welded piping systems. For more information on this subject, ask for Catalog 48.

MIDWEST PIPING COMPANY, INC.

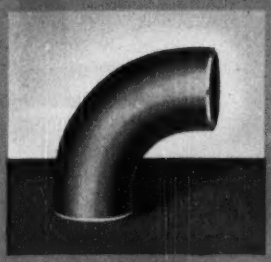
Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and Boston

Sales Offices:

New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

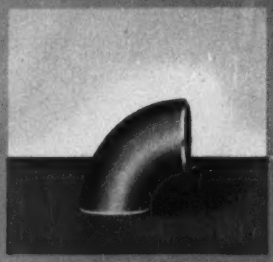


MIDWEST "LONG TANGENT"

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 24".

ASA STANDARD

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings. ASA B16.9. Tolerances much less than allowable. Sizes to 26".



SHORT RADIUS

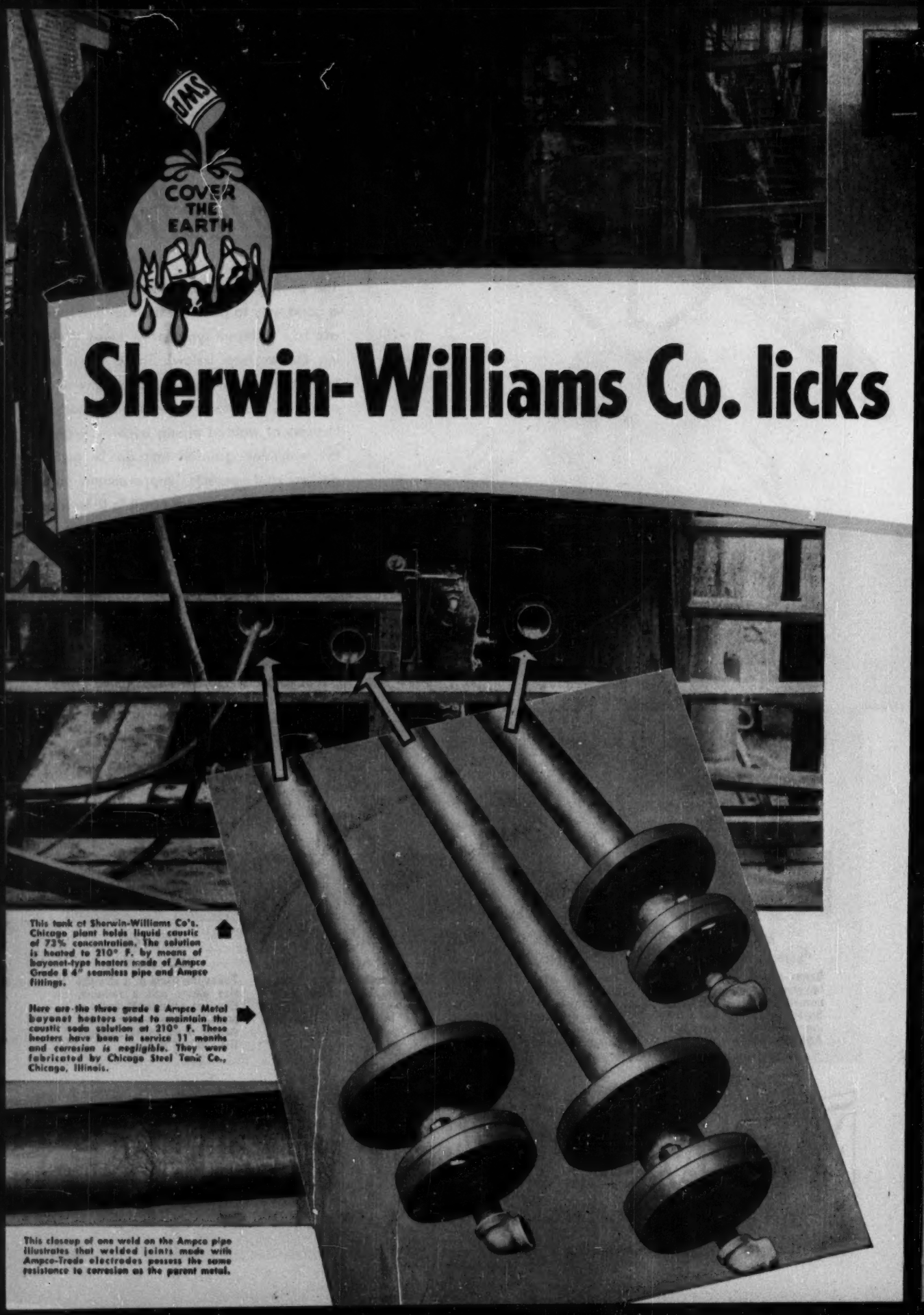
Recommended where space is limited. Sizes to 30". Also available with "Long Tangents" in sizes 14" to 20".

MIDWEST REDUCING

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 12", reductions to half size.

MIDWEST WELDING FITTINGS

IMPROVE PIPING DESIGN AND REDUCE COSTS

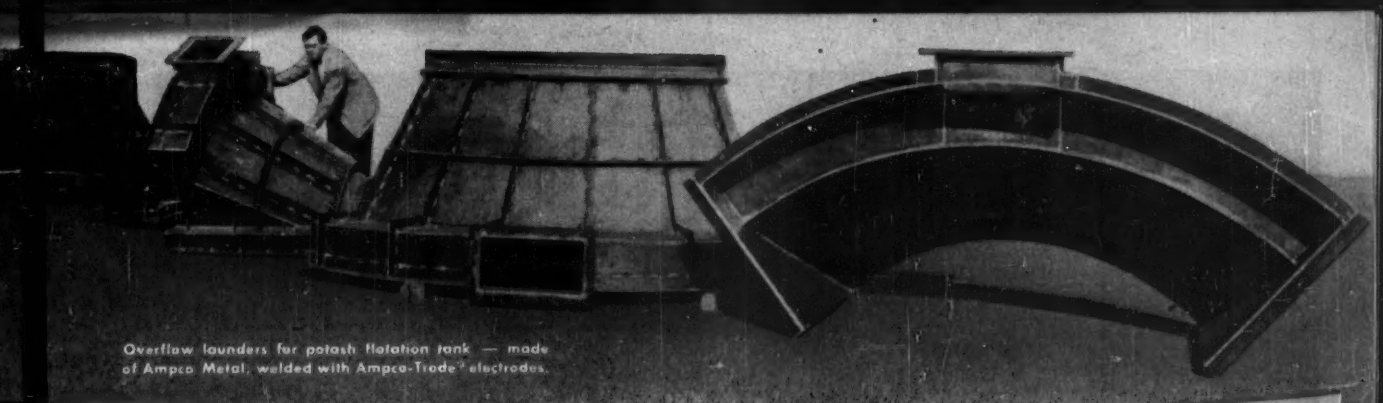


Sherwin-Williams Co. licks

This tank at Sherwin-Williams Co's. Chicago plant holds liquid caustic of 73% concentration. The solution is heated to 210° F. by means of bayonet-type heaters made of Ampco Grade 8 4" seamless pipe and Ampco fittings.

Here are the three grade 8 Ampco Metal bayonet heaters used to maintain the caustic soda solution at 210° F. These heaters have been in service 11 months and corrosion is negligible. They were fabricated by Chicago Steel Tank Co., Chicago, Illinois.

This closeup of one weld on the Ampco pipe illustrates that welded joints made with Ampco-Trode electrodes possess the same resistance to corrosion as the parent metal.



Overflow launders for potash flotation tank — made of Ampco Metal, welded with Ampco-Trode* electrodes.

CAUSTIC CORROSION *with* AMPCO* METAL

Like Sherwin-Williams Co., manufacturer of top-quality paints, an ever-increasing number of companies in the process and petro-chemical industries are using Ampco Metal to solve corrosion and many other problems.

Here's why! Ampco Metal Grade 8, one of a series of engineered aluminum bronze alloys, has these important properties: high resistance to corrosion...high tensile strength (75,000 psi)...high physicals at extreme temperatures... high strength-to-weight ratio... high impact and fatigue values (Charpy @ −423° F., 93 ft. lbs., @ 70° F. 75 ft. lbs. fatigue limit 28,000 lbs. @ 100,000,000 cycles)... high resistance to wear from erosion, abrasion, cavitation-pitting... high compressive strength (E. L. in Comp. 25,000 psi)... high modulus of elasticity (18,000,000)... easy to fabricate with Ampco-Trode* welding wire and coated electrodes.

Ampco Grade 8 has Boiler Code Approval and is available in sheet, plate, extrusions, pipe, tubes and fasteners. It may be the solution to your corrosion problems. Consult your nearest Ampco Field Engineer or write us for further information.

Hasco valves — made entirely of Ampco Metal.

Tear out this coupon and mail today!

*Reg. U. S. Pat. Off., Ampco Metal, Inc., Milwaukee, Wis.

Ampco Metal, Inc.
MILWAUKEE 46, WISCONSIN
West Coast Plant
BURBANK, CALIFORNIA

AMPCO

AMPCO METAL, INC., Dept. CE-12 Milwaukee 46, Wis.

Send me information on the application of Ampco Aluminum Bronzes for corrosion-resistant service in the Process Industries.

Name.....Title.....

Company.....

Company Address.....

City.....(.....) State.....

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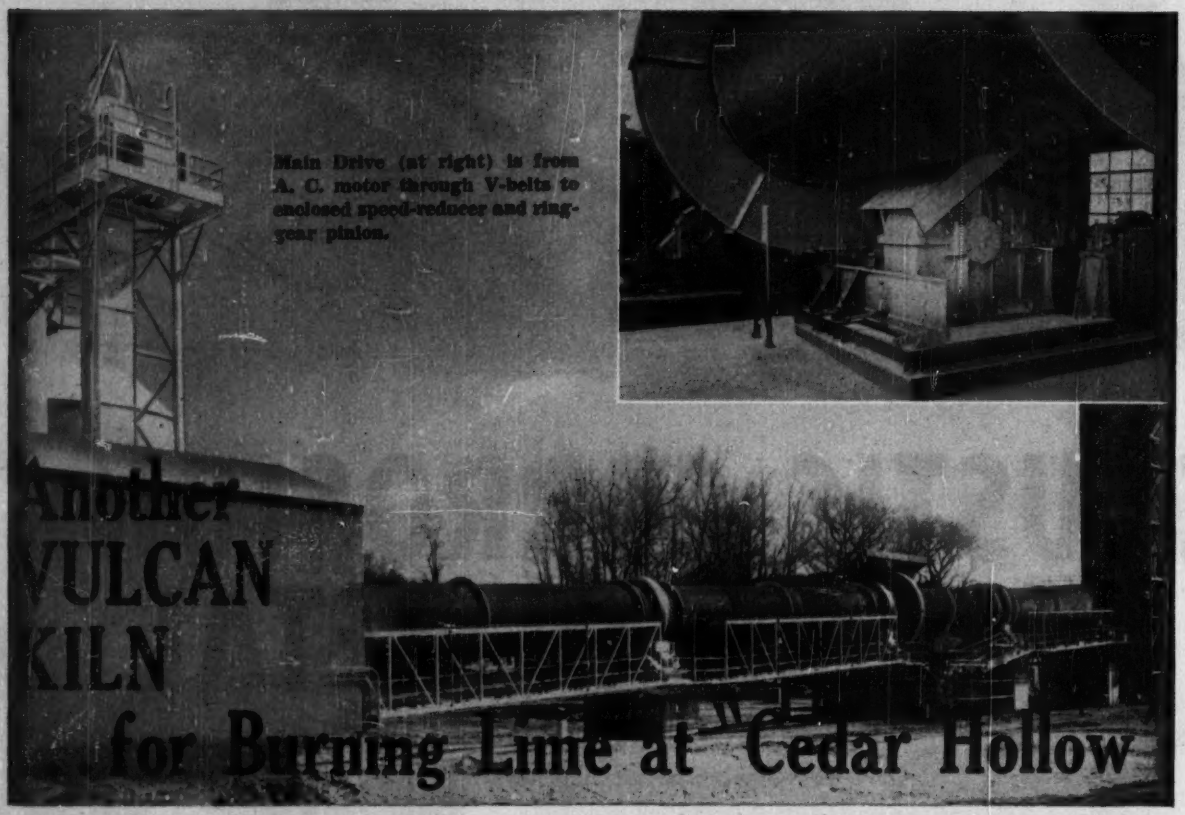
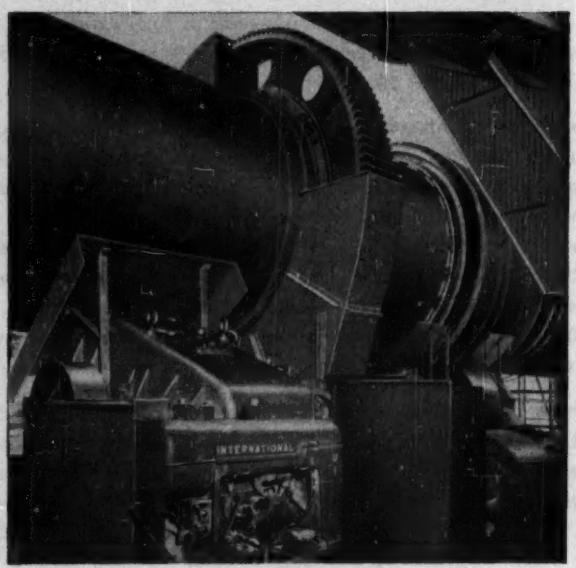

Main Drive (at right) is from A. C. motor through V-belts to enclosed speed-reducer and ring-gear pinion.
Another VULCAN KILN for Burning Lime at Cedar Hollow

When the Warner Company's Cedar Hollow, Pa. plant first went into operation, in 1916, it was equipped with an 8′ x 150′ Vulcan Rotary Kiln which is still in operation and still giving good service. To meet the need for greater capacity, however, another Vulcan Rotary Kiln has recently been installed as shown in the illustrations.

The new kiln is not only much larger (9′ x 300′) but also embodies every modern feature to assure efficient, economical operation. The very heavy all-welded steel shell is mounted on our latest-type supporting roller and thrust bearings; all of which are automatically lubricated and easily adjusted to compensate for wear or moderate misalignment. Main drive and auxiliary drive both have an ample margin of power over any probable requirement and are as fully enclosed as possible, to promote cleanliness and safety. Other features, specified by the Warner Company's experienced engineers and production executives, assure maximum capacity and minimum fuel consumption under their particular operating conditions.

Detailed information regarding Vulcan Rotary Kilns for lime plants, cement plants, and other modern applications is given in our 28-page, fully illustrated, bulletin No. A-442. Write for it if you can use it to advantage.



Auxiliary Drive (above) is from gasoline engine through Morse clutch-coupling and V-belts to same enclosed speed reducer as for main drive.

VULCAN IRON WORKS

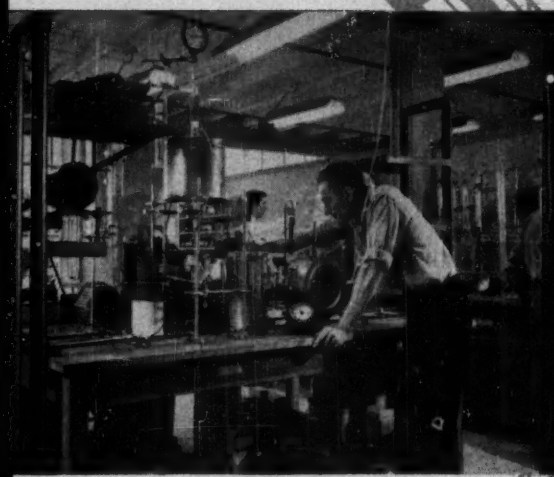
Established 1849

Main Office and Works **WILKES-BARRE, PA.,** New York Office 50 Church

Rotary Kilns, Coolers and Dryers	Double-Roll Briquetting Machines	Heavy-Duty Electric Hoists	Steam Locomotives
Rotary Retorts, Calciners, Etc.	Open-Hearth Steel Castings	Self-Contained Electric Hoists	Diesel and Gasoline Locomotives
Improved Vertical Lime Kilns	Steel-Plate Fabrication	Scraper-Loading Hoists	Diesel-Electric Locomotives
Automatic Quick-Lime Hydrators	Shaking-Chute and Chain Conveyors	Cast-Steel Sheaves and Gears	Electric Locomotives and Larrys

RESEARCH – PRODUCTION

Baker-developed Platinum Metals Catalysts provide by far the highest yield and catalytic activity at low temperatures and pressures—the purest end-product and most efficient production control. Industrial and pharmaceutical chemical manufacturers are also making the very profitable discovery that Platinum Metals catalysis is in many instances considerably more economical than catalysts of the base metals and oxides—in large as well as small-scale production. Certainly, the possibilities-for-advantage warrant investigation.



. . . FOR A GRAM OR A TON

BAKER RESEARCH AND PRODUCTION SERVICE: Here, the world's largest Platinum Metals Catalyst research and production facilities are maintained for a complete service to industrial and pharmaceutical chemical manufacturers.

If catalysis is a part of your production or if you are developing a product or process involving a catalytic stage, call a Baker research representative for consultation—in full confidence and without obligation.

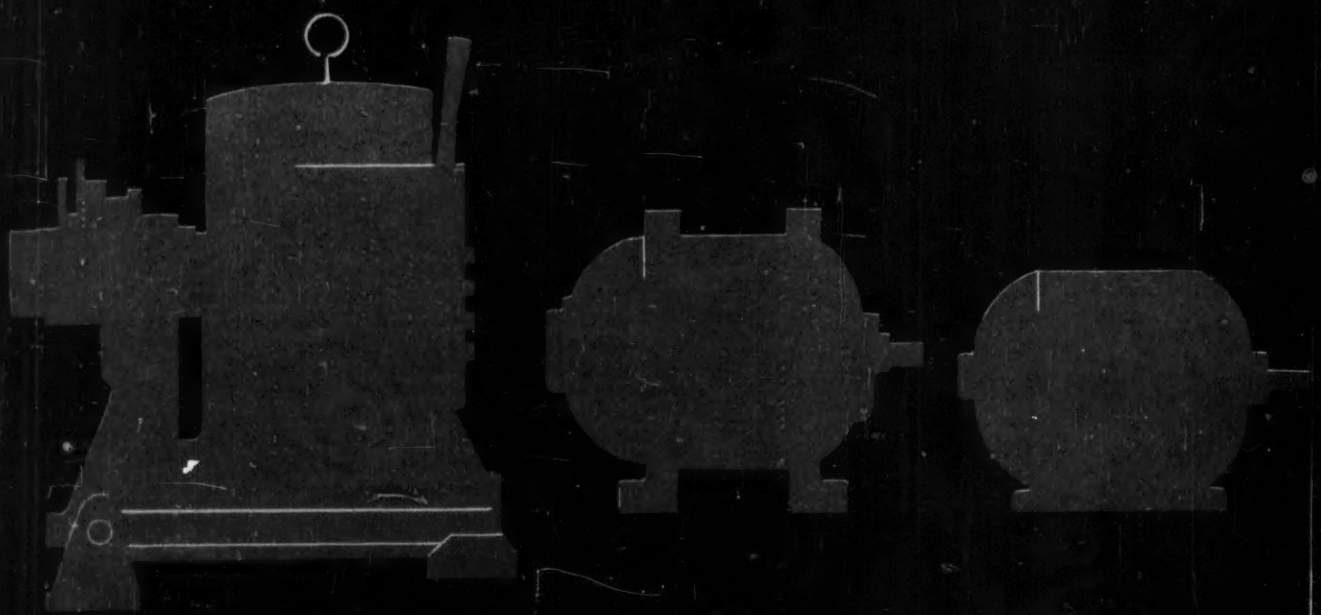
Send for new file bulletin "SELECTIVE HYDROGENATION BY PLATINUM METAL CATALYSTS"

BAKER & COMPANY, INC.
CATALYSTS

113 ASTOR STREET · NEWARK, N. J.

THE HUB OF PLATINUM METALS RESEARCH

WHAT'S NEW IN MOTORS



1888
TESLA
5 H.P.
765 LBS.

1926
CS
5 H.P.
130 LBS.

1947
LIFE-LINE
5 H.P.
119 LBS.

IS STILL TO COME . . .

Hear anything about a new motor? Well, if you think you have, let's set the record straight . . . What's New In Motors Is Still To Come!

Westinghouse has been a leader in the designing and manufacturing of motors for over 60 years. During these many years, over 20 million dollars has been spent on the development of basic lines of induction motors to maintain this leadership. Here are the real years of "new motors" in the parade of progress:

1888—*THE FIRST A-C MOTOR—THE WESTINGHOUSE TESLA MOTOR*

1926—*THE FIRST SEALED SLEEVE BEARINGS—THE WESTINGHOUSE CS MOTOR*

1947—*THE FIRST MOTOR WITH PRE-LUBRICATED BEARINGS PLUS A ⅓ WEIGHT AND SIZE REDUCTION—THE WESTINGHOUSE LIFE-LINE MOTOR*

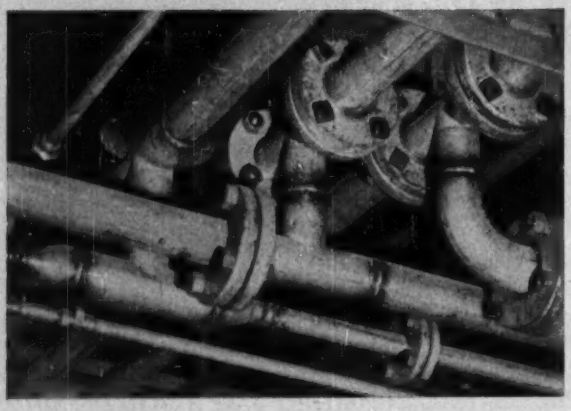
The smaller, lighter Westinghouse Life-Line Motor of 1947 was the last major contribution. *AND FOR THE NEXT ALL-IMPORTANT STEP AHEAD IN MOTOR PROGRESS . . . LOOK TO WESTINGHOUSE.*

YOU CAN BE SURE.. IF IT'S Westinghouse

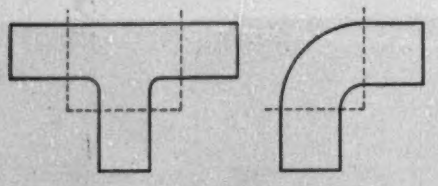
J-21834

HOW TO SAVE MONEY ON STAINLESS PIPING

the *Speedline* system cuts cost, increases flow and capacity



Speedline Ells, Tees, Insert Flanges, and Concentric Reducer installed on 2-inch Schedule 5 Stainless Pipe in a plastics plant.



Look for the "Tangential Feature"

These drawings show a *Speedline* Tee and 90° Elbow. The dotted lines show the termination points of conventional fittings. The additional straight section of *Speedline* Fittings permits attaching of unions or flanges without fouling, reduces the number of welds required, and eliminates troublesome curved or angle joints. The tangential feature is common to all *Speedline* Fittings such as Ells, Tees, Crosses, etc.

● It will pay you to look into this new idea in corrosion-resistant piping. By using light wall stainless pipe and versatile *Speedline* Fittings, piping costs have been reduced 10% to 50% . . . and at the same time, flow and capacity of the line has been increased!

Here's the way it works:

If you are now using Stainless Pipe . . .

. . . chances are that it is the conventional Schedule 40. But this heavy wall is not needed in 90% of the cases. Light wall Schedule 5 pipe costs about half as much, and all sizes will easily withstand 150 p.s.i. working pressures. *Speedline* Fittings are specially designed for fast, low-cost installation of light wall stainless pipe lines. And because light wall pipe of the same size has a larger inside diameter than heavy pipe, you gain 15% to 25% greater flow and capacity!

If you are now using Stainless Tubing . . .

. . . the *Speedline* system offers real savings and advantages. It permits you to change to a light wall *pipe* rather than *tubing* size—at no increase in cost. And here's where you gain. Standard equipment like valves, pumps, sight gauges, etc., are made in *pipe* sizes—you hook right in without special adapters! And equally important, *piping* permits you to use the next lower dimension (for example, 1" Sch. 5 pipe has even greater capacity than 1¼" O.D. tube). This means that you can use smaller valves, flanges, and other accessories—an entire installation would be considerably lower in cost.

***Speedline* distributors are located in principal cities from coast to coast**

***Speedline* Corrosion-Resistant FITTINGS**

—the newest thing in pipeline economy

Manufactured by **HORACE T. POTTS CO.** • 500 E. Erie Avenue • Philadelphia 34, Penna.

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"CATS" are Famous

--for earthmoving results

...all types of alloys...bars...plates...

supplied by CASTLE

MOVING THE EARTH--on a sugar plantation in Africa...in a molybdenum mine in Colorado...for a new highway in Nova Scotia...to extend jet plane runways at Fort Benning. Ga.--these are typical of the many and varied jobs where Caterpillar-built equipment proves its superiority. The DW10 Tractor with No. 10 Scraper, shown above, and many other earthmoving units are built by Caterpillar Tractor Co., Peoria, Ill. And, A. M. Castle & Co. is proud to be a factor in the production of these outstanding, world-famous earthmoving units.

FOR OVER 61 YEARS--Castle has been supplying all types, grades, sizes, and finishes of steel to thousands of large and small customers all over the United States. And regardless of the tonnage or dollar volume--each customer receives quick, friendly, cooperative service--on each and every order.

PHONE CASTLE FOR STEEL--any type, kind, size, shape, or quantity. Nine large, heavily stocked, completely equipped warehouses stretching across the country assure you of fast delivery--whatever your address. Why not reach for your phone right now?

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EVERYTHING IN STEEL

COLD FINISHED BARS • STAINLESS STEELS • HOT ROLLED BARS • TOOL STEELS • ALLOY STEELS • SHEETS PLATES • STRUCTURAL and many others in a large variety of sizes, grades, and finishes--for immediate delivery.

from coast to coast

A. M. CASTLE & CO.

STEEL DISTRIBUTORS

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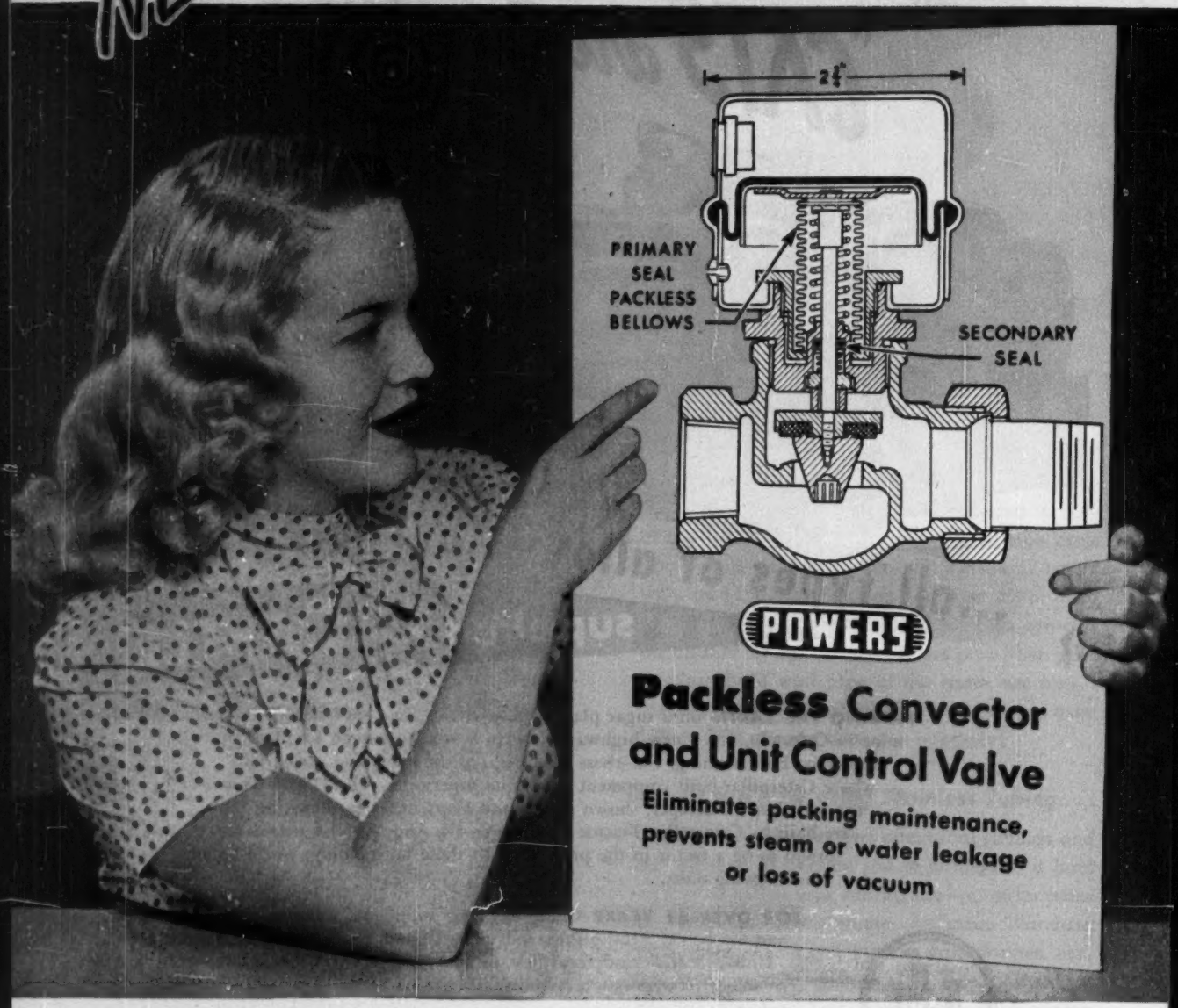
NEW! POWERS PNEUMATIC Systems of



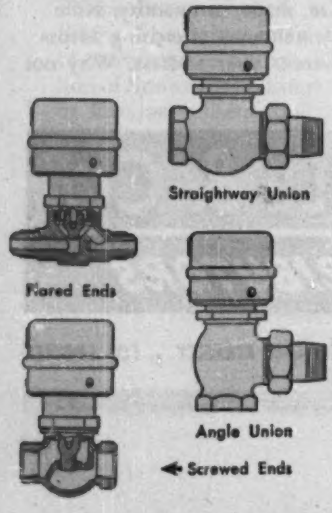
Packless Convector and Unit Control Valve

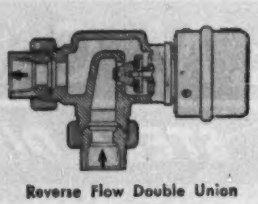
Eliminates packing maintenance, prevents steam or water leakage or loss of vacuum

POWERS-PACKLESS-VALVES

Never require re-packing.

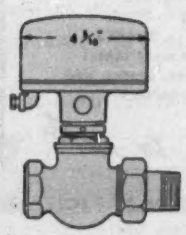
Real Economy in Maintenance year after year



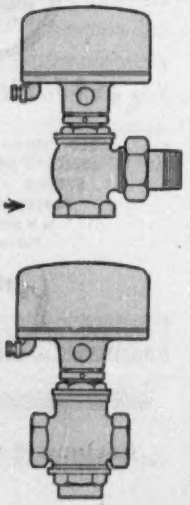


Reverse Flow Double Union

Available in various types and sizes for control of convectors, unit ventilators, unit air conditioners and radiators.



Straightway Union



Automatic Temperature Control

Now Include

POWERS-PACKLESS-VALVES

For Controlling Convectors, Unit Ventilators, Unit Air Conditioners and Radiators.

Now, at NO Extra Cost — users of Powers pneumatic control systems will get the additional benefits of still lower operating and maintenance costs — insured by Powers packless valves.

Duo-seal Construction Gives Them Superior Performance. Bronze packless bellows is the Primary Seal which eliminates packing maintenance — packing friction — steam and water leakage or loss of vacuum. Secondary Seal permits servicing of valve top without draining the water system or shutting off the steam supply.

Typical Specifications for POWERS-Packless-Pneumatic Control Valves

Control valves for convectors, radiators and unit ventilators shall be packless type with bronze packless bellows to eliminate steam and water leakage or loss of vacuum. This packless bellows shall be located so that it is not subject to corrosive action of the steam or water. A spring-loaded secondary seal shall be provided to permit convenient inspection or servicing of valve top without draining the water system or shutting down the steam supply.

Valve sizes shall be determined by control manufacturer for capacities specified. Type of valve body and valve top to be used shall be as required to best satisfy the application.

Valves shall be equipped with phosphor bronze bellows or Neoprene diaphragms of sufficient size to close off against specified line pressures. Diaphragms shall be replaceable. Valves shall be equipped with characterized throttling plugs to insure a measured flow of steam or water in direct relationship to the demand of the controlling thermostat.

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Skokie, Ill. • Offices in Over 50 Cities in the U. S. A., Canada and Mexico
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OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

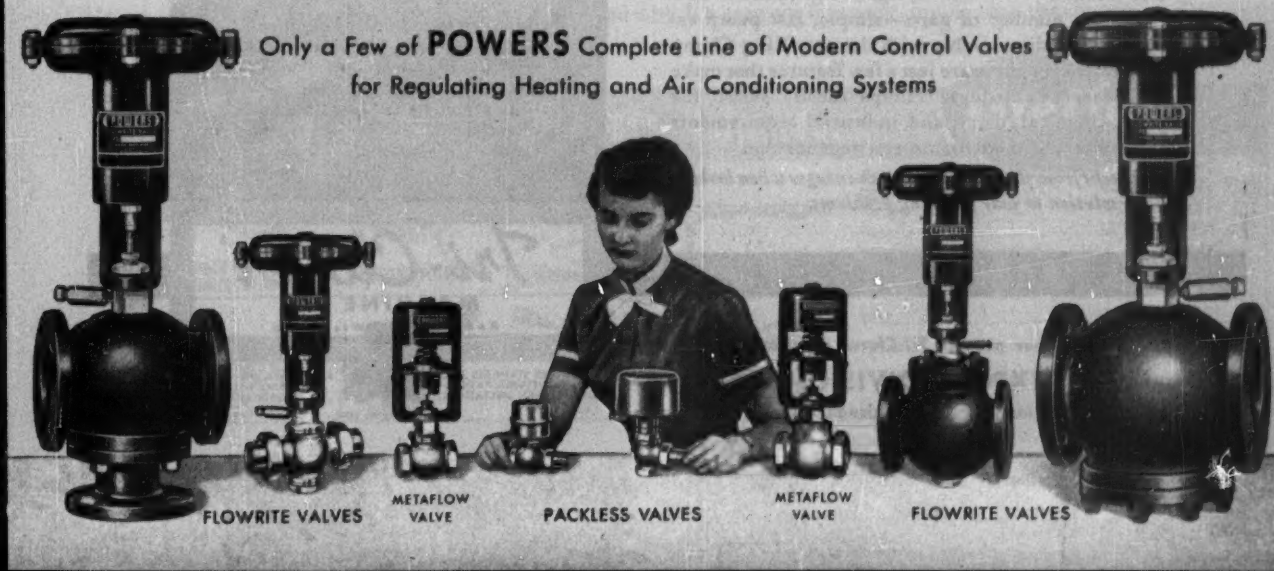
Banish PACKING Maintenance

No Loss of Vacuum

... leakage of air reduces efficiency of heating system and increases corrosion in return lines

No Steam or Water Leakage

(b18)


Only a Few of POWERS Complete Line of Modern Control Valves
for Regulating Heating and Air Conditioning Systems
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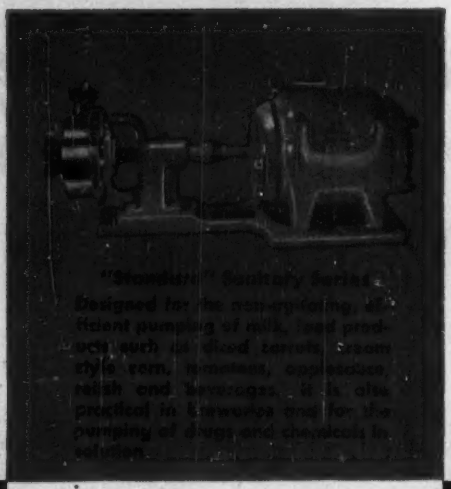
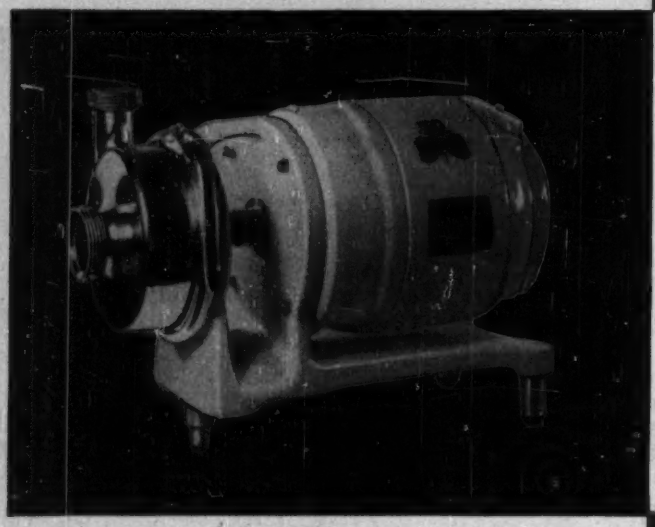
METAFLOW VALVE
PACKLESS VALVES
METAFLOW VALVE
FLOWRITE VALVES

You'll find all the features you want in

TRI-CLOVER PUMPS





"Pump King" Unimount Series

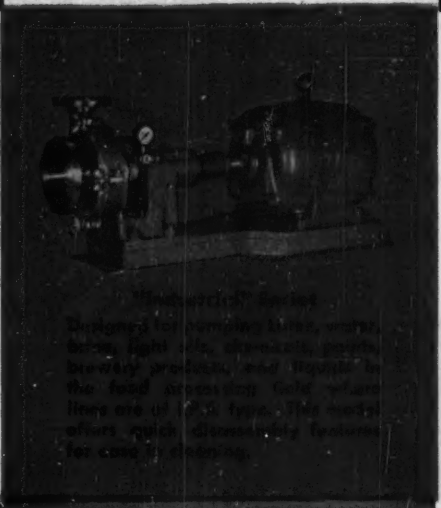
Designed for very efficient operation at 1800 and 3600 RPM, and especially where high speeds are required, through heaters, coolers, filters, clarifiers, etc. The 3600 RPM model is especially applicable in the dairy industry where high head and low capacity are essential and for handling low and medium viscosity liquids in the food processing industry.

OVER 30 years of continuous improvement is embodied in today's line of Tri-Clover centrifugal pumps.

The "Pump King" Sanitary Series—the Standard Sanitary Series—and the Industrial Series—all have exclusive Tri-Clover pump features that mean better, more efficient liquid transmission.

Patented screw type impeller with sanitary impeller clip—inert carbon seal that is easily removed and cleaned—streamlined, lightweight head with a minimum number of parts—simple, fast pump assembly and disassembly with the new Ring Clamp construction—these are just a few features that make Tri-Clover Centrifugal Pumps ideally suited for food, chemical, dairy, and industrial requirements for sanitary and corrosion-resistant service.

Benefit from these important advantages when looking for a solution to your pumping problems.



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FABRICATED STAINLESS STEEL INDUSTRIAL FITTINGS AND INDUSTRIAL PUMPS

THE Complete LINE

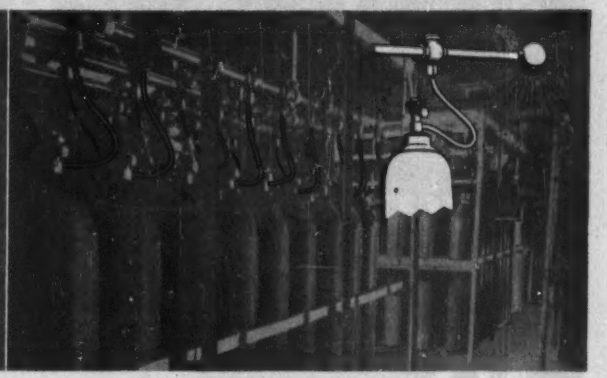
See your nearest Tri-Clover distributor.

P-153

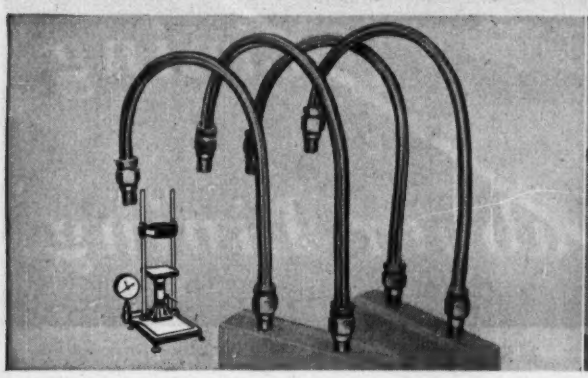
EXPORT DIVISION
8 So. Michigan Ave., Chicago 3, U.S.A.

Pick an idea—lick a design problem...

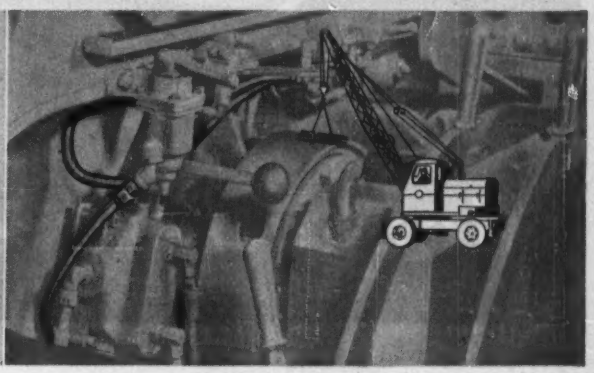
END VIBRATION AND LEAKAGE. Titeflex® metal hose, used as fill and drain lines of SEC Synthetic Cleaning Units, kills vibration and prevents solvent leakage at fittings. Tough, wear-and-corrosion-resistant Titeflex is just as effective in handling steam, oil, lubricants, fuels, gases, brine, acids, compressed air or oxygen. Design and construction of Titeflex assure trouble-free performance. Excellent for projects involving extreme configurations.



CONTROL CRITICAL PRESSURES. How would you connect 280 cylinders of fire-extinguishing carbon dioxide at 850 psi to line? Walter Kidde & Company licked this problem with Titeflex flexible metal hose which met all insurance standards and withstood rigid application requirements. Titeflex also conveys hundreds of different fluids under as many different temperature and pressure conditions. Resists corrosion, vibration, physical abuse.



CONDUCT STEAM SAFELY. Plates for Carver Laboratory Press carry steam up to 200 psi (nearly 400°F.) for heating—water for cooling. The connections are flexible, pressure-safe Titeflex. Braiding gives extra strength. Added problems of vibration, pulsation, continuous movement, corrosion or abrasion make Titeflex invaluable in scores of other applications.



FIGHT FATIGUE AND WEAR. Titeflex metal hose eliminated maintenance on air control lines of Unit Mobile Cranes. All-metal construction, with braiding woven directly upon the hose, provides great strength and resistance to vibration, corrosion, wear and abuse. Flexibility of Titeflex permits simplified assembly even where space configurations are problems.

THE USES FOR TITEFLEX® seamed flexible metal hose and Uniflex seamless flexible metal hose are limited only by engineering ingenuity. And Titeflex design engineers—working *with* customers—develop new applications daily. Somewhere in your plant or on your products Titeflex can improve operation and maintenance—or simplify a design problem. Our *new 48-page Metal Hose Catalog* No. 200 shows you how and why. To get your free copy, simply mail the coupon.

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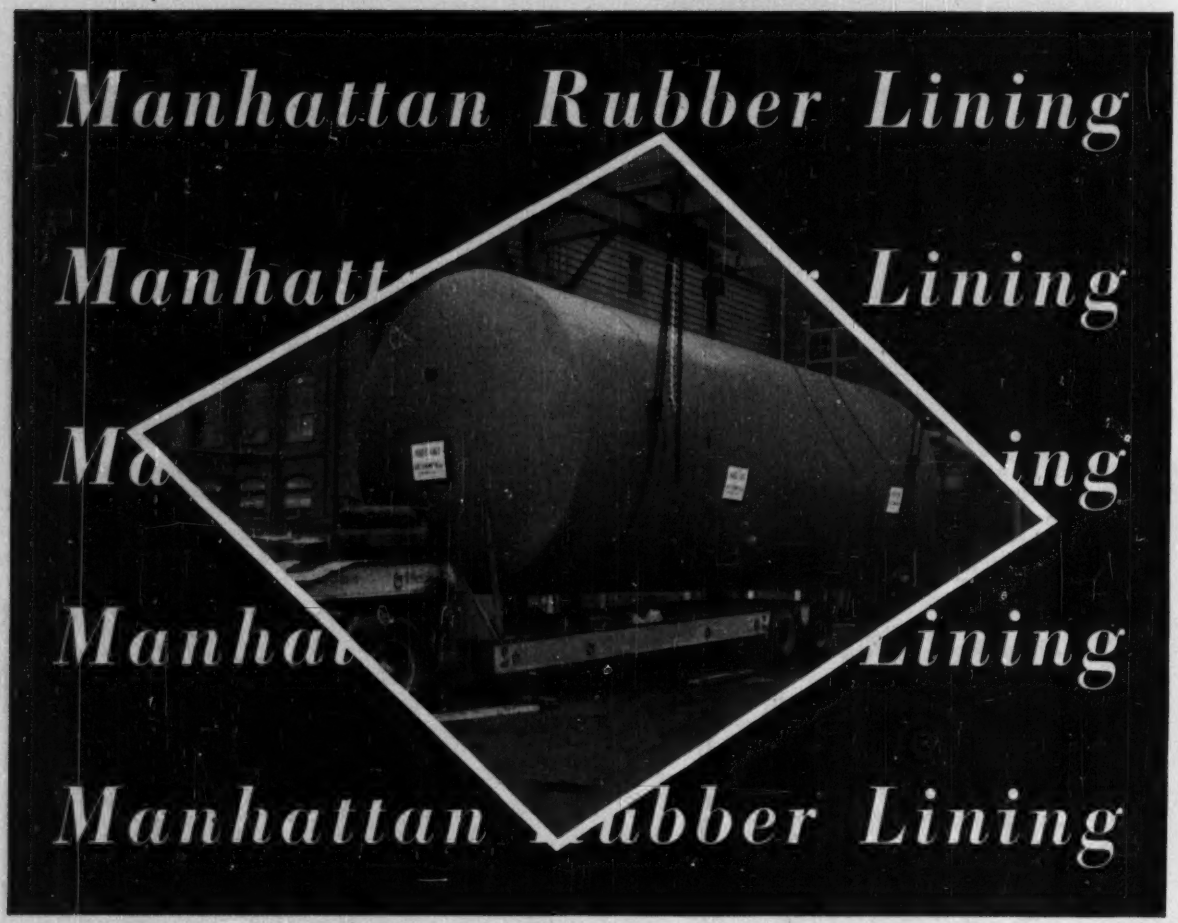

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Everything you look for in a reliable source for rubber lining is available at Manhattan. First, the *quality* of rubber, natural or synthetic, applied in calendered sheets of required thickness for utmost durability. Next, the *facilities* to handle any of your equipment that can be shipped by rail or truck – large or small – complex or simple. Finally, craftsmanship based on long *experience* – more than 60 years of rubber engineering.

Manhattan Rubber Lining resists abrasion, will not buckle or crack. It expands and contracts with metal under temperature changes. It presents a resilient, non-breakable surface that protects you *permanently* against loss from corrosion or contamination. No imperfections can go undetected because every Manhattan Rubber Lined Tank is tested dielectrically under 15,000 volts.

Call a Manhattan lining engineer for help with your anti-corrosion program.

RUBBER LINING PLANTS AT PASSAIC, N. J., AND NORTH CHARLESTON, S. C.

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MANHATTAN RUBBER DIVISION – PASSAIC, NEW JERSEY

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MASSACHUSETTS
Lawrence—Roland B. Glines Co.
Springfield—Elec. Motor Repair Co.

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Greensboro—Southern Elec. Serv. Co.
Rocky Mount—Hammond Elec. Co.

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Toledo—Romanoff Elec. Motor Serv.
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UTAH
Salt Lake City—Diamond Electric Motor Repair

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Roanoke—Virginia Armature Co.

WASHINGTON
Spokane—Lee F. Austin Company

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Charleston—Charleston Elec. Supply
Fairmont—West Virginia Armature Co. of Fairmont, Inc.
Morgantown—Gatis Elec. Repair Co.

WISCONSIN
Baraboo—Utility Trans. & Equip. Co.
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Wausau—Electric Motor Service
Wisconsin Rapids—Staub's Elec. Wks.

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Of course, Allis-Chalmers Certified Service Shops give good service on any electrical equipment, of any make. Tear out this ad and save it, or write the name of the A-C Certified Service Shop nearest you in your address book. Allis-Chalmers, Milwaukee 1, Wisconsin. 4197

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PUMPS — Integral types from ¾ in. to 72 in. discharge and up.

Trusted by all!

As you see here, even Justice trusts the scales. With them she can establish the truth with an easy mind. In the same position are all who wish to see mutual services justly distributed. In doing this they are helped by scales. To them are entrusted decisions concerning important possessions. Those who build weighing machines must never loose sight of this fact. They must give of their best in order that their machines may justify the confidence of the buyer. Schenck Weighing Machines are designed on this principle by experienced engineers according to the latest findings of the weighing technics, and are appreciated all over the world as an approved aid in answering difficult weighing problems. The Schenck manufacturing programme comprises beside the delivery of large weighing machines for all industrial and commercial purposes particularly **Automatic Weighing Machines for rope ways and narrow gauges, BeltWeighers, Weigh-Feeders, special Batch and Hopper Scales for mixing plants, etc.** If you attach importance to enstrusting the weight control of your factory to high quality weighing devices, we recommend you to consult our experienced Schenck engineers. Please write for information concerning the possibilities of cooperation to

Carl Schenck Maschinenfabrik Darmstadt GmbH · Darmstadt

GERMANY

ENGINEERING News

Here's SK's NEWEST DESIGN for Rate-of-Flow Measurement—the SAFEGUARD ROTAMETER

As an answer to industry's increasing demands for *safety* and *convenience* in rate-of-flow measurement of liquids and gases, SK has designed its newest Rotameter—the Safeguard Rotameter.

This Rotameter has specific application for measurement in the higher temperatures and pressures of modern process technology, or where dangerous or valuable liquids and gases are being used.

FOR SAFETY:

The completely enclosed steel meter case has detachable safety glass windows, protects the metering tube from external shock, and also protects the operator if accidental tube breakage occurs.

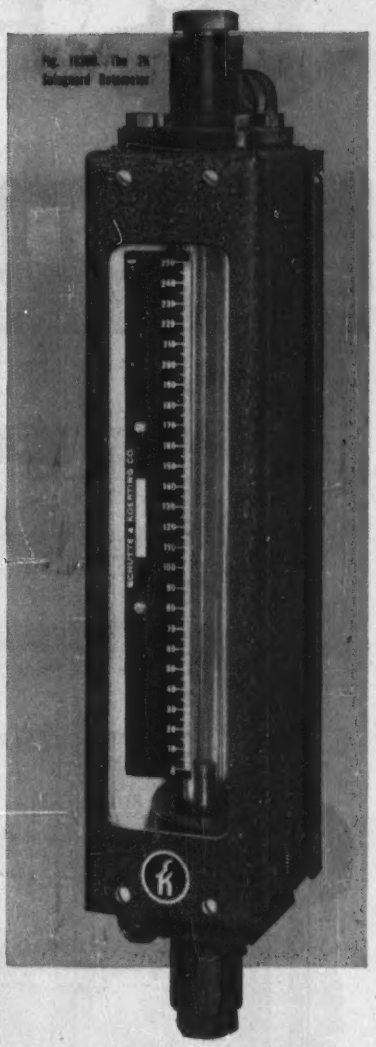
FOR CONVENIENCE:

Wider front and rear sight glass windows give maximum visibility. The detachable metal reference scale can be supplied in either units of flow or in millimeters for use with calibration charts, as desired.

Extreme construction rigidity gives precise end fitting alignment, eliminates pipe stresses on the tube.

Can be adapted for remote recording and controlling of fluid rate of flow.

Write for full information, including sizes and capacities, on this newest Rotameter design.



Glass metering tube has cylindrical inlet and outlet pieces of *the same outside diameter* — allowing use of the same size packing rings on either end of the tube.

Horizontal inlet and outlet can be connected in four different positions.

Two types of metal mandrel made tubes are available—the "HCF," a High Capacity Fluted tube, or the "R," a conical tapered tube without flutes.

Various rotor designs and materials permit wide capacity range within one meter.

End fittings are available in cast iron, bronze, and stainless steel.

Neoprene packing gives corrosion resistance, tight seal, long service life. Other packing material is available.

Rotor removal and tube cleaning without dismantling easily done through non-leaking seated clean-out plug.

SCHUTTE and KOERTING Company

Manufacturing Engineers

13 STATE ROAD
CORNWELLS HEIGHTS
BUCKS COUNTY, PA.

Be sure to see *MULLING*
demonstrated at the
1953 CHEMICAL SHOW
... look for Booth 410

SIMPSON *MIX-*
NATIONAL ENGINEERING

SEE
MULLING
DEMONSTRATED

You'll see the versatile new Simpson "LF" Mix-Muller in action . . . the result of over 37 years of mixing research and engineering . . . setting a new standard of laboratory control.

Here is your opportunity to see exactly what Simpson Mulling is . . . and how this intensive rubbing, smearing, blending action can do a better, faster preparation job on dry, pasty or wetted material.

It will pay you to look for Booth 410 at the 1953 Chemical Show, to learn how Simpson Mix-Mullers re-create the desirable blending action of the chemist's mortar and pestle . . . on a full-scale production basis.

If you can't make the Show this year, write for further details on how Simpson Mix-Mullers can help solve your specific mixing problems.

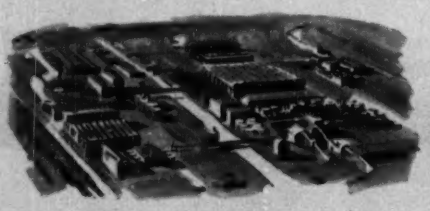
new

REYNOLDS ACTIVATED ALUMINA

for your gas and liquid drying processes!

REYNOLDS METALS COMPANY

a basic source of this important desiccant



HURRICANE CREEK—This mammoth Arkansas plant is the source of high quality Reynolds Activated Alumina

Now look to Reynolds Metals Company for high-quality Reynolds Activated Alumina. Here is a basic new source of this important drying agent . . . a source with tremendous reserves of raw material and production facilities.

Large scale refinements in one of Reynolds Arkansas plants over the past year now assure you of dependable and increasing supplies of Reynolds Activated Alumina for your process equipment, packaging and drying of gases and liquids.

If you are looking for reliable, constant supplies of this versatile drying agent, contact the Reynolds office listed under "Aluminum" in your classified telephone directory, or write direct to Reynolds Metals Company, 2567 South Third Street, Louisville 1, Kentucky.

See "Mister Peepers" Sundays on NBC-TV. Consult local listing for time and station.

REYNOLDS CHEMICALS

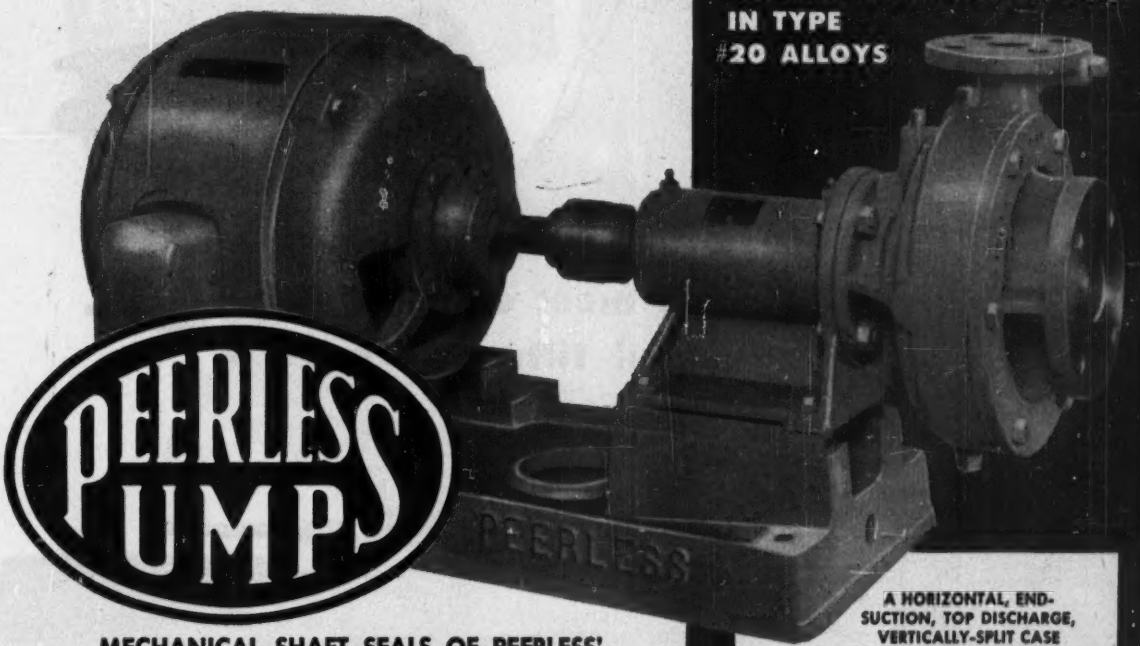
FROM THE PRODUCERS OF REYNOLDS ALUMINUM

PEERLESS type CTB CHEMICAL TRANSFER PUMP...

For continuous or intermittent light duty in transferring process chemicals

Featuring:

MECHANICAL SEAL DEPENDABILITY
RUGGED CONSTRUCTION
QUALITY MATERIALS
QUICK MAINTENANCE
LOW INITIAL COST AND AVAILABILITY FROM STOCK IN TYPE #20 ALLOYS



A HORIZONTAL, END-SUCTION, TOP DISCHARGE, VERTICALLY-SPLIT CASE CENTRIFUGAL PUMP

CAPACITY RANGE:	10 to 250 gpm
HEAD RANGE:	10 to 140 feet
HP RANGE:	¼ to 10 hp
CASE PRESSURE:	100 lbs.
LIQUID TEMPERATURE:	Up to 250°F
MATERIALS OF CONSTRUCTION:	Frame—cast iron Liquid End—Type No. 20 Stainless steel alloy

MECHANICAL SHAFT SEALS OF PEERLESS' OWN DESIGN AND MANUFACTURE ELIMINATE STUFFING BOX TROUBLES AND SHAFT LEAKAGE

Since the Type CTB chemical transfer pump is designed with and for a mechanical shaft seal and the stuffing box is eliminated, the Type CTB pump has less shaft overhang, reduced bearing loads, less run-out at the seal. This design also effects a sizable reduction in both pump and seal costs. The seal is Peerless' own design and construction and is available from stock.

DESIGNED AND CONSTRUCTED TO ASSURE LOW OPERATION COSTS AND LONG "IN SERVICE" CONTINUITY

Extra heavy bracket and frame construction imparts rigidity to the unit and precise alignment provides smooth running performance. Pump is equipped with heavy duty, grease lubricated ball bearings. Semi-open impeller, with repelling vanes on back of shroud minimizes recirculation losses and reduces pressure on shaft seal providing optimum seal performance. You can buy and apply the Peerless Type CTB pump with confidence. Availability of complete units and components is excellent from ample factory stocks.

WRITE FOR BULLETIN TODAY

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Los Angeles, California and Indianapolis, Indiana. *Offices:* New York, Atlanta, Chicago, St. Louis, Phoenix, Fresno, Los Angeles; Dallas, Plainview and Lubbock, Texas; Tulsa, Albuquerque, N. M. *Distributors in Principal Cities;* Consult your Telephone Directory.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26
Los Angeles 31, California

Please send us a copy of Peerless Type CTB Pump Bulletin No. B-1606.

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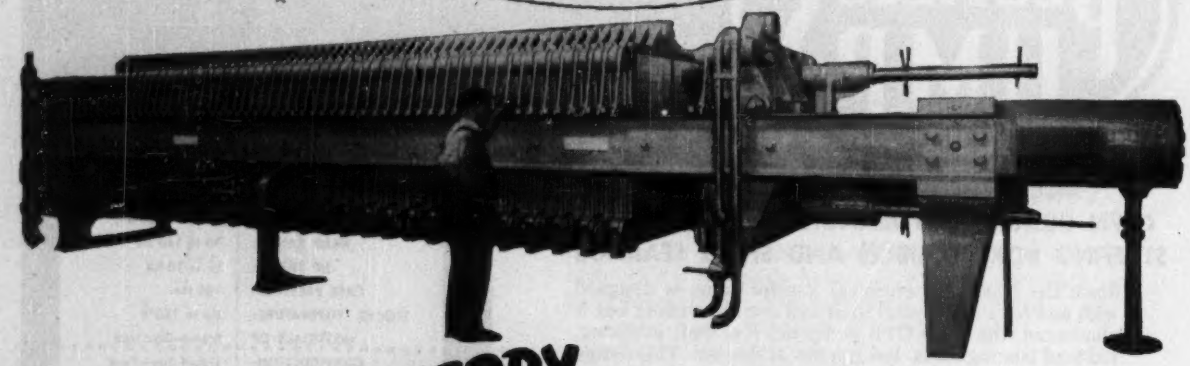
CHEM. ENG.

a size and design to meet every industrial filtration need



SPERRY FILTER PRESSES

Whatever your requirements may be, you can depend on Sperry to provide a filter press to exactly meet specifications . . . center, side or corner feed, open or closed delivery, provision for simple or thorough washing, jacketed plate for filtering at controlled high or low temperatures . . . for use with filter bases of cloth, paper, metal screens, composition screens or combinations . . . with a choice of six different closing devices.

For over fifty years, manufacturers have looked to Sperry for the finest in filters — for hundreds of applications. Proved performance has distinguished Sperry Filter Presses throughout industry.

Complete details are included in the big free Sperry catalog. Send for *your* copy.

D. R. SPERRY & COMPANY

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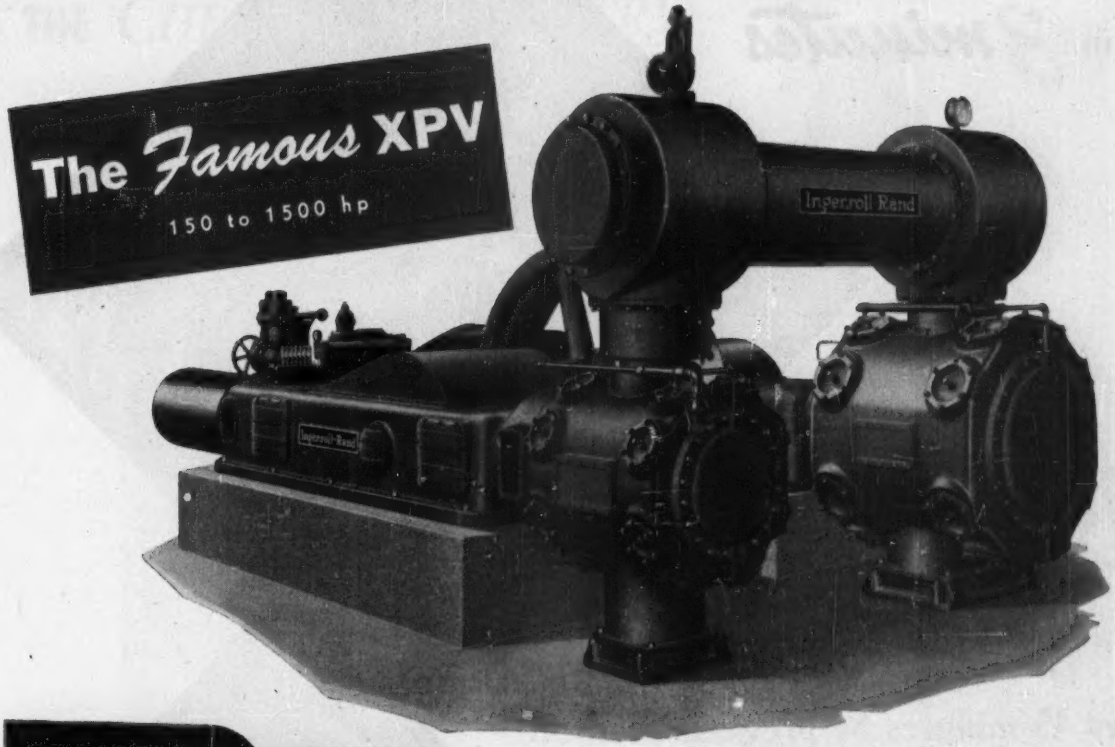
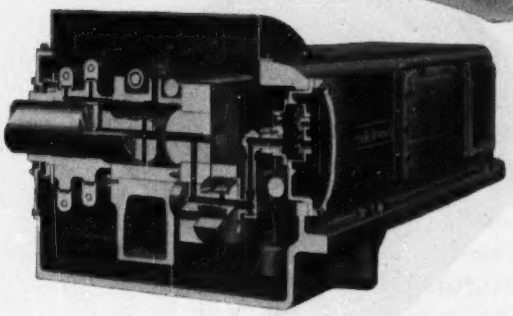
Sets the Standard for STEAM-POWERED COMPRESSORS





This cross-section through one of the main bearings of the new XPV shows its unique lubrication system. The combination oil-pump drive and distribution system (patented) supplies oil through drilled passages directly to the crankpin and main bearings, valve-gear eccentrics, and crossheads.

All of the oil discharged from the pump passes through a fine-mesh bronze filter before entering the distribution system. The oil stays clean and bearing surfaces are protected.

Because the frame is sealed, oil stays in; and dust and dirt stay out. The oil in the crankcase keeps clean, and the smooth contours of the frame make it easier to keep clean outside.

Ever since the first steam-powered compressor of "4-corner" construction was built by Ingersoll-Rand in 1900, I-R "steamers" have been the standard of comparison. Through the following years, other models introduced such precedent-breaking improvements as: balanced piston-valve riding cut-off steam end, double-crosshead and tie-rod construction, and Channel Compressor Valves.

The new XPV sets a truly new standard of comparison. Many of the outstanding features of the old XPV have been retained because of their advantages. Many improvements have been introduced to make a superior compressor.

One of the outstanding features of the new XPV is its full-floating bearings. Main, crankpin, and crosshead-pin bearings are all free to rotate; rubbing speeds are reduced, and bearing loads and lubricant are distributed evenly around the entire bearing surface both inside and out. The wear on these non-adjustable bearings is almost non-existent, and the sealed, dust-tight frame need be opened only for inspection.

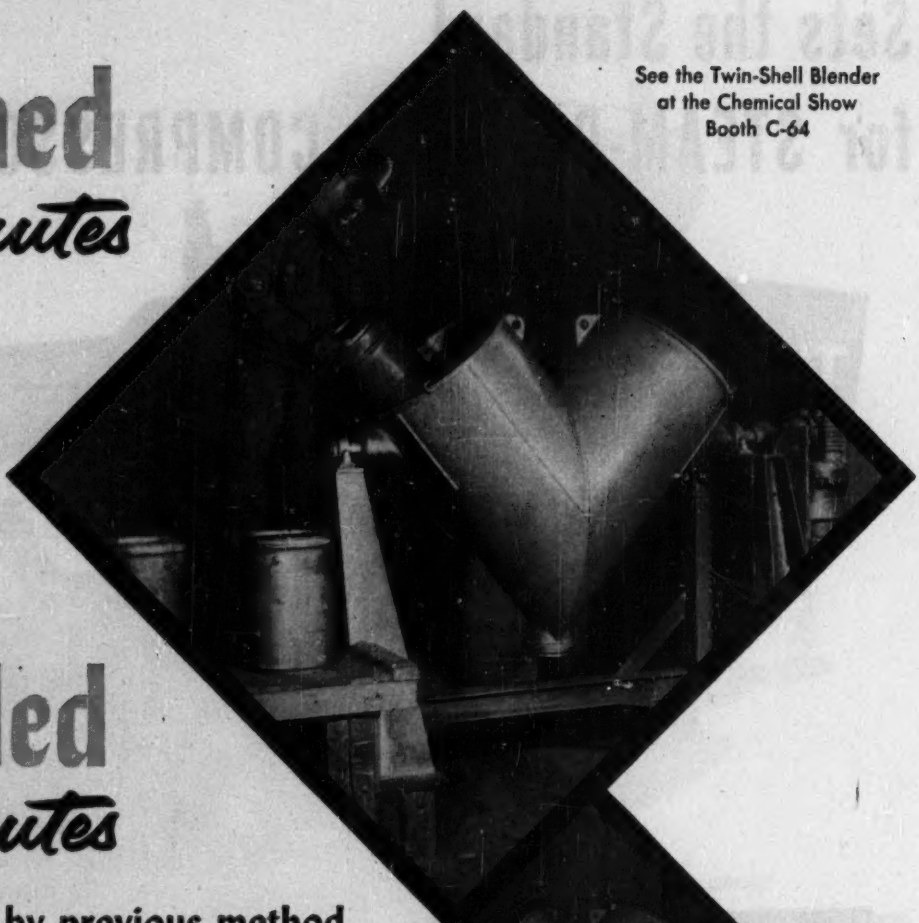
Part by part, and as a complete unit, the new XPV has been designed to compress air or gas with the greatest over-all efficiency. For further information ask the nearest I-R branch office for Bulletin 3444-A. Call upon Ingersoll-Rand engineers to prove why you should use this new XPV, the new standard of comparison.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 578-1

Cleaned in 3 minutes

See the Twin-Shell Blender
at the Chemical Show
Booth C-64



Blended in 3 minutes

vs 45 minutes by previous method

More thorough blending in *one-fifteenth* the time has been the experience of one manufacturer of hard-to-blend finely divided powders, assuring a completely thorough blend in three minutes that formerly required as much as 45 minutes to one hour and without any assurance of thoroughness. One blender replaces former methods which required a separate drum for every mix.

Now, clinical cleaning between batches is completed in only three minutes thanks to the baffle-free shell and the large charging openings. Discharge is also fast, with powders delivered directly to shipping containers on a scale platform.

In your own process work there is a place where p-k twin shell blenders can revolutionize your blending procedures. p-k maintains a blending laboratory where your blending problem can be pre-tested. Send a sample of your materials for a complete blending analysis, without obligation.

Write for Catalog No. 12

simply designed for better blending

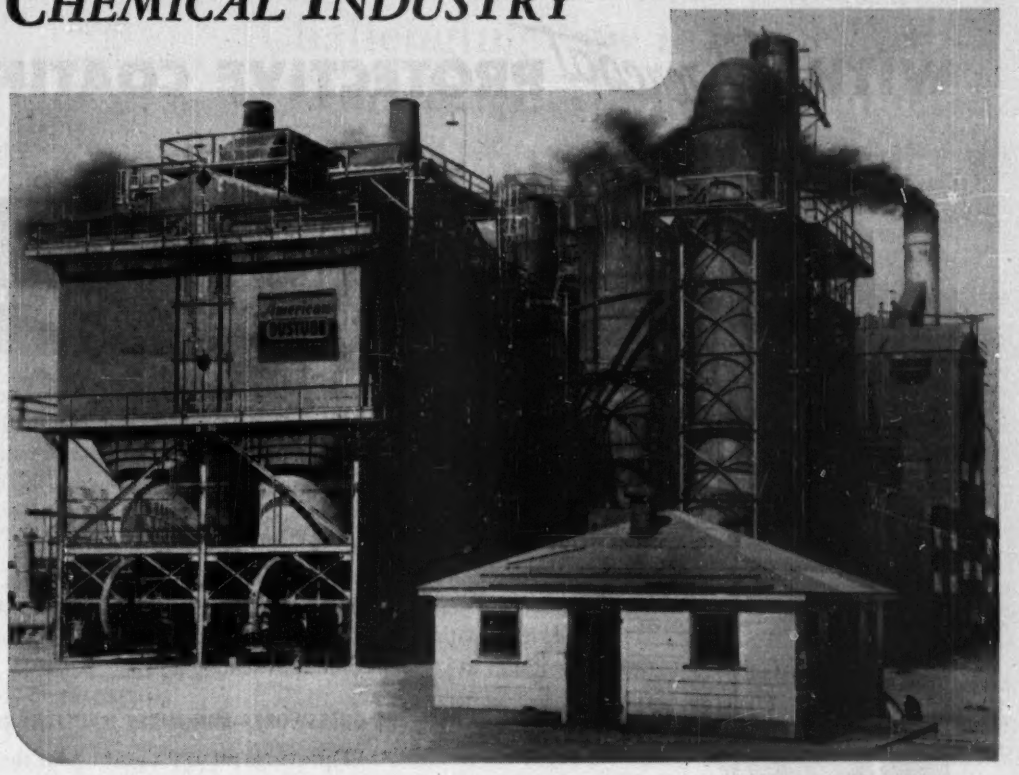
the **Patterson-Kelley Co.,** inc.

220 Lackawanna Avenue, East Stroudsburg, Penn.

1953

101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston 16 • and other principal cities.

WHAT dustube COLLECTORS EFFICIENCY MEANS IN THE CHEMICAL INDUSTRY



A CLEAN STACK WITH CARBON BLACK

No visible discharge from the two stacks equipped with Dustube Collectors at Cabot Carbon Company! Virtually 100% recovery of extremely fine particle size carbon black is accomplished by the Dustubes filtering the material from 55,000 c.f.m. gas at 275° F. From 10 to 15% of the production of this valuable material had formerly been lost to the atmosphere.

Filtration efficiency like this is typical of the Dustube in the chemical industry because it is the most dependable method of dust removal that will insure a "clean stack" under a wide variety of operating conditions.

With the new synthetic fabrics, the high efficiency Dustube can now be used under temperature and corrosive conditions in applications heretofore beyond the scope of cloth collection.

For your dust and fume control problems it will pay you to investigate the Dustube—the dust collector that combines simplicity, efficiency and dependability. Write for complete information today.

Catalog 72-B tells why Dustube is a more efficient method of dust and fume control. Write for your copy now.

American WHEELABRATOR & EQUIPMENT CORP.
347 S. Byrkit St., Mishawaka Ind.

dustube COLLECTORS

YOU CAN *Specify* MINIMUM MAINTENANCE COSTS WITH *Amercoat* PROTECTIVE COATINGS

ONLY AMERCOAT PROVIDES YOU WITH

The most complete line of corrosion resistant coatings available anywhere

Field service backed by an organization SPECIALIZING in corrosion control

The service life of your equipment—the efficiency of your production schedules — the ultimate value of your investment and maintenance dollars — all are vitally dependent on the continuing performance of the protective coatings specified in your plant. Thus, success or failure of your coatings can mean the difference between tremendous losses or substantial savings.

To assure coating performance that provides long-lasting, low-cost protection, two steps are absolute essentials, right from the start. You need the right coating for each specific exposure, and it must be applied properly if it is to yield maximum benefit.

AMERCOAT ELIMINATES THE GUESSWORK—MINIMIZES MAINTENANCE COSTS

First of all, AMERCOAT provides the right coating for the particular problem. From the complete AMERCOAT line, it is possible to provide specific coatings for specific exposures to achieve specified protective performance.

In addition, you receive the added value of AMERCOAT's conscientious service follow-through backed by an organization SPECIALIZING in industrial corrosion control. With the assistance and on-the-spot advice of a trained representative, you get the best possible application through proper attention to surface preparation and correct coating techniques.

Investigate AMERCOAT now. It's your surest way to effective, long-term corrosion control. An experienced representative is near you to serve you. For complete details write today.

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U.S.I. CHEMICAL NEWS

★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★

Polyester Possibility: 'Glassless' Greenhouses Easy to Build and Heat

Hobbyists, gardeners, and commercial growers were recently offered an interesting innovation in greenhouses — a detailed plan for building a 16-foot by 24-foot reinforced plastic and aluminum structure with many built-in advantages over conventional glass types.

The plan provides for use of shatterproof panels of polyester-fiber glass which are said to transmit 80 to 90 per cent as much light as pure air. With their low heat transmission (40 per cent that of glass), the panels could make possible sizeable reduction in heating costs. Growing plants which touch the sides of the panels, even in freezing weather, are reported to remain unharmed.

Other advantages claimed for this unusual greenhouse material: Diffused light admitted by the panels makes leaf burn controllable. Condensation is reduced to a minimum. Need for hail insurance is eliminated. Larger panels make possible wider framing and less shadow. And wooden or concrete sills are unnecessary because the panels can go directly into the ground. The panels are impervious to rot, rodents, and mildew, and they may be sawed, drilled, nailed, or attached with screws, it is said.

On-the-Spot Separation Gives Iodine Isotope Longer Half-Life

An unusual technique was revealed recently whereby a useful but short-lived iodine isotope can be made available for longer periods of time and at greater distances from radioactive isotope sources. Iodine-132 can be used to advantage in therapy or detection of certain abnormal body conditions. However, its half-life is only about 2.5 hours, making it impractical to use as a tracer or therapeutic agent.

The parent compound of I^{132} is tellurium-132, which has a half-life of 77 hours. The new technique involves recovery and shipping of radiotellurium and letting the user separate I^{132} as it is needed. Since the iodine isotope is constantly being formed in the parent material, this method gives it a longer effective half-life. A simple apparatus has been developed for effecting the separation easily and quickly, according to the report.

Cosmetic Manual Available

A new cosmetic and drug manual containing the latest formulas for many commercial products is now available. Formulas and working directions are given for making creams (emollient, greaseless, make-up, hand, protective, hair, shaving, and deodorant), lotions, shampoos, and similar products. Pharmaceutical formulas include ointment basis, medicated ointments and dermatitis lotions. Sections are also devoted to emulsion techniques and cosmetic raw materials.

Challenging New Intermediates From U.S.I. Allethrin Synthesis Now Offered for Industrial Use

U.S.I. Announces Commercial Availability of Five Versatile, Highly Reactive Organic Chemicals; Plans Release of Other Allethrin Intermediates

A series of five new chemical intermediates — possible "building-blocks" for future pharmaceuticals, perfume materials, fungicides, insecticides, fine chemicals, and other products as yet unforeseen — are now available to challenge the imaginations of the industry's research chemists. The new chemicals are themselves intermediates in U.S.I.'s complex industrial synthesis of allethrin. They represent the first of a number of such intermediates U.S.I. plans to offer for investigation and evaluation in the synthesis of other chemical products.

Offer Unusual Functionality

Newness of these chemicals makes it difficult to predict specific applications at this time. However, the interesting characteristics of these products will suggest varied uses in commercial organic syntheses.

Following are brief descriptions of the five allethrin intermediates being offered at the present time. Further information on these compounds, including data sheets which discuss availability and price of experimental and commercial quantities, may be obtained from the Chemical Sales Department of U.S.I.

Allyl acetone — is an unsaturated, liquid ketone which undergoes polymerization reactions, as well as the customary reactions of the

MORE

Milk Protein Deficient In Sulfur Amino Acids

Recent work on the use of dried skim milk as the only source of protein in the diet of experimental rats has shown that milk protein is deficient in sulfur amino acids. Using a basic diet designed to contain 8% protein, an increase in growth rate was obtained with the addition of 0.2% L-cystine. An additional increase in growth resulted when DL-methionine was added to the diet containing 0.2% cystine. It was found that the methionine had the same effect as the combination of cystine and methionine. Further work indicated that 0.2% DL-methionine gave the best growth response with the protein level at 8%. Since it is known that the body can make cystine from methionine, but not methionine from cystine, these findings are logical.

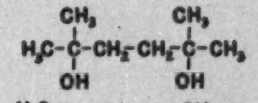
In the past, *in vitro* studies have shown that there is no loss of sulfur amino acids by

MORE

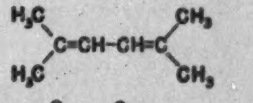
NEW U.S.I. INTERMEDIATES AVAILABLE IN COMMERCIAL AND EXPERIMENTAL QUANTITIES

ALLYL ACETONE $H_2C{=}CH{-}CH_2{-}CH_2{-}\overset{O}{\overset{\|}{C}}{-}CH_3$

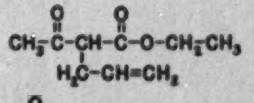
2,5-DIMETHYLHEXANE-2,5-DIOL



2,5-DIMETHYL HEXADIENE-2,4



ETHYL-α-ALLYLACETOACETATE



ETHYL DIAZOACETATE $H_2C{-}CH_2{-}O{-}\overset{O}{\overset{\|}{C}}{-}CH{=}N{=}N$

U.S.I. CHEMICAL NEWS

CONTINUED *Allethrin Intermediates*

double bond, the ketone group, and the terminal methyl group.

2,5-Dimethylhexane-2,5-diol — is a mildly aromatic crystalline glycol which undergoes such reactions as cyclization on treatment with dehydrating agents, ammonia, or amines. One or both of its hydroxyl groups can be reacted to produce esters, ethers, etc.

2,5-Dimethyl-2,4-hexadiene — is a highly reactive liquid hydrocarbon of symmetrical structure which contains two conjugated double bonds. It lends itself to a variety of condensation reactions, including the Diels-Alder reaction with various dienophils.

Ethyl-α-allylacetoacetate — is subject to the wide variety of reactions typical of acetoacetates. It can be reduced with sodium and alcohol to yield β-allyl ethanol. It reacts with hydrazine hydrate to form an allyl-substituted methyl pyrazolone, and with phenols to form allyl-substituted methyl unbelifferones.

Ethyl diazoacetate derivatives—ethyl diazoacetate has been known for a long time and has been used widely in various laboratory syntheses. One of its many unique applications is its addition to aliphatic as well as aromatic double bonds to form cyclopropane derivatives.

In spite of the many applications already known for this chemical on a laboratory scale, commercial use has been handicapped up to now by its relative instability and handling hazards. However, in the commercial production of allethrin, U.S.I. now has extensive facilities designed to handle large quantities of ethyl diazoacetate safely. While it is impractical to supply ethyl diazoacetate as such even in sample quantities, U.S.I. is prepared to make these facilities available to other manufacturers for the synthesis of various derivatives. Research chemists and others interested in its possible use are invited to contact U.S.I.'s Chemical Sales Department, 120 Broadway, New York 5, N. Y.

CONTINUED Milk Protein Deficiency

any method of drying, and that milk proteins are inherently low in cystine and methionine.

Further work is needed on the use of milk in human nutrition with regard to supplying adequate methionine. As a pioneer producer of DL-methionine, U.S.I. carries strategically located stocks for supplying this amino acid to the animal feed and pharmaceutical industries.

Develop New Test For Soil Phosphorus

A rapid and reliable test has been developed for measuring soil phosphorus in both acid and alkaline soils, according to a recent announcement. Information from the test is said to indicate, with greater accuracy than tests commonly used, where the addition of phosphate fertilizer will produce a response in increased crop yields. The new method is based on relatively new knowledge of the reactions of calcium phosphates in the soil and the influence of these reactions on plant uptake of phosphorus. The test can be made in less than an hour and is readily adapted to routine procedures.

During the past two years, the test has been used to measure phosphorus fertility in more than 200 soils from various sections of the country. Using the uptake of radioactive phosphorus as a measuring stick, workers have found a close correlation between the amount of phosphorus taken up by the plant and the extent to which yields are increased.

Field results with the new method indicate that most soils showing a level of less than 50 pounds of phosphoric oxide per acre will respond with increased crop yields when phosphates are added. Above that figure, no response would generally be expected from phosphate additions except in such crops as potatoes which have a small root-zone feeding area, it is said.

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U. S. I.

A new flame proofing chemical for cotton is claimed to make fabric impervious to combustion up to 4,500° F. and to resist repeated laundering and dry cleaning. **(No. 980)**

DL-Ethionine, a methionine antagonist and inhibitor of some tumor growths, is now available as a research tool in methionine metabolism investigations and cancer studies. **(No. 981)**

A new aerosol valve for pressurized products is designed to operate at the slightest touch when the valve head is moved in any direction. Device is said to allow faster pressure filling than any other on the market. **(No. 982)**

Electric socks, similar in principle to electric blankets, are now available for hunters, skiers, other cold-feet sufferers. Warming wires are interwoven, connect by insulated wires to a small battery worn on the belt. **(No. 983)**

Paper thermometers, graded series of heat-sensitive coated papers, are calibrated to determine temperatures from 113° to 580° F. with accuracy of 1%, change permanently from white to black at stated temperatures. **(No. 984)**

An effective rust-removing, corrosion-retarding, and paint-conditioning technique for metal is reportedly available in a single treatment with a new acid phosphate cleaner. Conditioner imparts superior impact-resistance to paint, the manufacturer states. **(No. 985)**

A new brake-lining compound contains copper to dissipate heat and lead to act as lubricant. One application is claimed to give increased safety and to nearly double life of the lining. **(No. 986)**

A new, stable organic active chlorine compound has been announced commercially. Compound contains at least 66% available chlorine, of which only 2% is lost after storage for 14 weeks at 140° F., according to the producer. **(No. 987)**

Pipe leaks can be sealed quickly, it is claimed, with a new cast iron fitting which encloses the leak within synthetic rubber gaskets, forms a gas-tight chamber that equalizes pressure inside and outside the pipe. **(No. 988)**

New silicone resins can be foamed to form lightweight, nonflammable reinforcing or insulating structures of high compressive strength. Half-inch sections are claimed to show no significant decomposition on being brought to red heat in open flame. **(No. 989)**

PRODUCTS OF U.S.I.

ALCOHOLS
Amyl Alcohol (Isoamyl Alcohol)
Butanol (Normal-Butyl Alcohol)
Fusel Oil — Refined
Propanol (Normal-Propyl Alcohol)

Ethanol (Ethyl Alcohol)
Specially Denatured—all regular and anhydrous formulas
Completely Denatured—all regular and anhydrous formulas
Pure—190 proof U.S.P., Absolute—200 Proof
Solox*—proprietary solvent—regular and anhydrous

ANTI-FREEZE
Super Pyro* Anti-Freeze
U.S.I. Permanent Anti-Freeze

ETHERS
Ethyl Ether, U.S.P.
Ethyl Ether, Absolute—A.C.S.

ACETONE—A.C.S.

ANSOLS
Ansol* M
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OXALIC ESTERS
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Diethyl Oxalate

PHTHALIC ESTERS
Diamyl Phthalate
Dibutyl Phthalate
Diethyl Phthalate

OTHER ESTERS
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Ethyl Chloroformate

RESINS (Synthetic and Natural)
Arachem*—modified types
Aradure*—urea-formaldehyde resins
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Ester Gums—all types
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INSECTICIDE MATERIALS
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CPR Concentrates: Liquid & Dust
Piperonyl Butoxide
Piperonyl Cyclonene
Pyrenone* Concentrates: Liquid & Dust
Pyrethrum Products: Liquid and Dust
Rotenone Products: Liquid and Dust

INSECTIFUGE MATERIALS
Indalone*
Triple-Mix Repellents

INTERMEDIATES
Acetoacetanilide
Acetoacet-ortho-chloroanilide
Acetoacet-ortho-toluidide
Acetoacet-para-chloroanilide
Ethyl Acetoacetate
Ethyl Benzoylacetate
Ethyl Sodium Oxalacetate

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Choline Chloride
Curbay B-G* 80
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Niacin, U.S.P.
Riboflavin Concentrates
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U.S.I. Vitamin B_{12} and Antibiotic Feed Supplements
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CIPC
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Nitrocellulose Solns.
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Division of National Distillers Products Corporation

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Your choice for strong, leakproof piping!

This TUBE-TURN Concentric Reducer is designed with the smoothest reductions and the strongest knuckle contours consistent with adequate tangent lengths and the end-to-end dimensions established for this type fitting by the American Standard. TUBE-TURN Reducers are superior to the pipe in bursting strength and their fatigue life equals that of the butt weld used to join them to the pipe.

For piping installations that are maintenance-free and have extra long life, specify TUBE-TURN Welding Fittings and Flanges. Your nearby TUBE TURNS' Distributor is at your service with industry's most complete line.

The Leading Manufacturer of Welding Fittings and Flanges

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ENGINEERING SERVICE

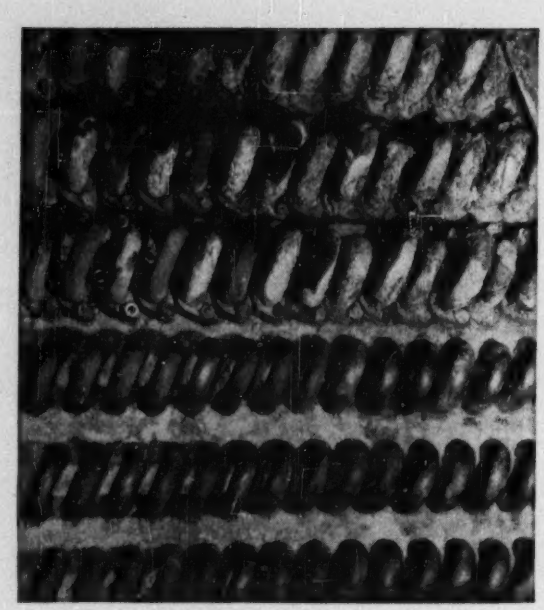
TUBE TURNS' *Engineering Service*

shows the way to eliminate equipment shutdowns

● In the past, directional changes in the tubes used in fuel economizers for boilers have been made with flanged U-bends or with header boxes. Although leakage was inevitable sooner or later, and repairs difficult, such conventional connections were necessary to permit periodic dismantling and mechanical cleaning.

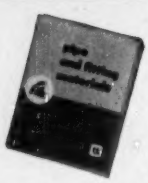
Now, improved methods of water treatment have eliminated the need for such cleaning in most cases, and with it, the need for joints that can be readily disassembled. Accordingly, TUBE TURNS' Engineering Service has recommended re-fabricating tube assemblies with TUBE-TURN 180° Welding Returns, which are available in thicknesses and radii to match the tube walls and centers of most economizers.

The result has been the elimination of any leakage in economizer tubing, thus ending shutdowns of economizers, boilers, and other critical equipment. In addition, pressure drop is reduced, and flow conditions improved. When you have a tough piping problem, bring it to TUBE TURNS' Engineering Service—a service that typifies TUBE TURNS' leadership in piping engineering.



At top: flanged connections in economizer. *At bottom:* permanently leakproof, TUBE-TURN Welding Returns.

Shop fabrication of welded piping assemblies is easy, thanks to the uniform wall thickness and dimensional accuracy of TUBE-TURN Welding Fittings. Line-up is fast and accurate.



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Position .....

Company .....

Nature of business .....

Address .....

City ..... *State* .....

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"tt" and "TUBE-TURN" Reg. U.S.Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

Will your new plant be obsolete before completion?

Some plants are "born old." A modern exterior that gives every indication of modern planning may hide old-fashioned thinking about equipment and processes — resulting in an unnecessary drain on manpower, materials, and profits.

Fast-moving technical innovations and the tightening competitive situation call for engineering skilled in modern design. WIGTON-ABBOTT CORPORATION has gained national recognition for its ability to comprehend and plan ahead for modern industrial trends. WIGTON-ABBOTT engineers are known for their up-to-date awareness of technical developments, and have in fact originated some of these developments, as reported in various trade journals.

Avoiding the failures of omission as well as commission is a must in planning today's new facilities with tomorrow in mind. Anything *less* exacts a severe penalty on production costs. WIGTON-ABBOTT welcomes your inquiry about your proposed new plant or the modernization of your present one. Write for our booklet, ***"Packaged Plant Construction."*** It may save you many disappointments.

Services for the Process Engineering Field

Economic surveys and analyses

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Development of new process

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Process design from client's flow sheet

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Conversion of existing facilities

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Design and construction from pilot plant data

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FOUNDED 1924
Main Offices: Plainfield, N. J.
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AIRETOOL SOLVES 2 major tube maintenance problems

Geared air driven condenser cleaner

CLEANING

Here's the cleaner for heavily scaled small diameter tubes in heat exchangers, condensers. A powerful low speed motor enables the operator to clean without tube injury. A flushing agent is introduced through the motor and drive shaft to keep the drill cool under all scale conditions. Special packing glands prevent leakage. Designed for thorough, safe cleaning of all scale conditions.

EXPANDING

It's new! Rolls tight tube joints automatically by the Retractive Method! Control is set to desired expansion, expander is fully inserted and rolls a short section of the tube. When full expansion is reached, the Expander then automatically retracts, expanding the entire thickness of the tube sheet. This method draws metal toward mouth of tube, prevents elongation, distortion or enlargement of holes, reduces time needed to roll tight joints.

Airetool Automatic Retractive Tube Expansion Control System — for installing tubes in heat exchangers, condensers, boilers.

Write for details about tube cleaning, tube expanding.

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AIRETOOL MANUFACTURING COMPANY
SPRINGFIELD, OHIO

THERE'S AN AIRETOOL TUBE EXPANDER OR TUBE CLEANER FOR EVERY TYPE OF TUBULAR CONSTRUCTION.

Advertisement.

Liquid Carry-Over Economically Controlled by Separators Made of Knitted Wire Mesh

When the removal of unwanted – and often contaminating – liquid particles entrained in a gas is considered as basically similar to the filtering of solid particles from the same type of carrier, the simplicity and effectiveness of knitted wire mesh entrainment separators is more readily understood.

Small section of a Metex Mist Eliminator opened to show construction.

Known as Metex Mist Eliminators, these separators are built up from layers of knitted wire mesh into a unit, foraminous in structure, which removes the liquid particles by impingement and accumulation in depth. Though operating on the same principle as air filters of this type, they have one distinct advantage. The filtrant being liquid will drain from the Mist Eliminator by gravity. Entrainment removal can therefore be considered as a "continuous" rather than a "batch" operation since the "filter" does not have to be cleaned.

Metex Mist Eliminators were first used about 10 years ago to remove the liquid entrainment in a fractionator tower in one of our leading petroleum refineries. The efficiency of, and the operating economies effected by, this first installation have since been repeated in unnumbered operations which include not only petroleum refining, but petrochemical and chemical processing operations in this country and abroad.

Mist Eliminators can be easily installed in new or existing vessels. They have no moving parts to require power or servicing and need no special housings. Experience shows that they will operate over an unusually wide range of velocities with a pressure drop generally less than 1" of water. Entrainment removal efficiencies of 99% and better are commonly reported. For full information write Entrainment Separator Department, Metal Textile Corporation, Roselle, New Jersey.

IDENTIFICATION DISC: An aluminum marking plate on all Walworth No. 225P's facilitates inventory control and makes reordering quick and positive.

take a good look at the Walworth "500 Brinell" no. 225P Globe

– the Toughest Bronze Valve Your Money Can Buy

The stainless steel, corrosion resistant seats and discs are heat treated to a hardness of 500 Brinell – hard enough to scratch glass and crush nails! The valve can be closed on sand, slag, and pipe scale without injury to the seating surfaces. "Wire drawing" is practically eliminated. All parts are accurately machined and gaged. Years of tight, positive shut-off are assured.

Available in both globe and angle types (angle type: No. 227P) in sizes ¼" to 2", this quality valve is recommended for 350 lbs. W.S.P. at 550 F, and 1000 lbs. non-shock service on cold water, oil, gas, or air.

For full data on this long-life, economical Walworth Bronze Valve, see your local Walworth distributor, or write for Circular.

NEWLY DESIGNED HANDWHEEL: Patented air-cooled, finger-fit handwheel affords sure grip even with greasy gloves.

IMPROVED PACKING: Molded packing of lubricated asbestos reinforced with copper wire. Suitable for practically every service. Valves can be repacked under pressure when fully opened.

note these 7 Great Features

HEXAGONAL UNION BONNET CONNECTION, DEEP STUFFING BOX AND RUGGED STUFFING NUT: Union bonnet connection eliminates any chance of distortion or leakage even though valve is repeatedly taken apart and reassembled.

OVERSIZE STEM: The high-tensile strength silicon-bronze stem assures long life and protection against wear.

SEATS AND DISCS: Plug type seats and discs of stainless steel, heat-treated to 500 Brinell hardness and machined simultaneously to a mirror-like finish, with accurate tapers assures tight positive shut-off with minimum handwheel effort.

EXTRA STRONG BODY: Made of Composition M (ASTM B61) bronze. Thick walls and rugged hexes provide a high safety factor. Valves undergo hydrostatic shell test of 1,000 psi.

WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

How a Georgia chemical company solves

For seven years the engineers at the Chemical Products Corporation plant in Cartersville, Ga., grappled with the difficult problem of handling a 32% hydrochloric acid solution containing traces of organics.

Three years ago, after successful tests, they installed PYREX brand "Double-Tough" glass pipe for this liquid-handling job—and solved the problem satisfactorily.

The hydrochloric acid (20° Bé.) is produced as a byproduct of a benzene chlorination operation, condensed from gas to liquid form. It is piped some 600 feet through the 2" PYREX pipeline, stored in outdoor tanks and used as required in other manufacturing processes.

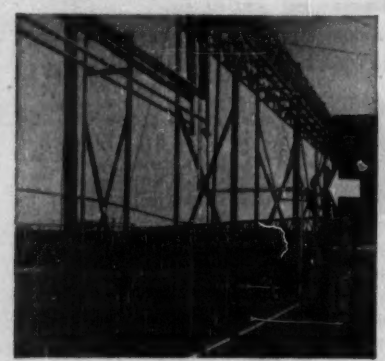
Outdoor temperatures ranging from 0° to 100° F. are encountered in this service. The acid itself is not heated.

Cost of maintenance cut to bone

During its three years of service the PYREX pipe has required no maintenance traceable to its use. The metal flanges and pipe joints are coated with Insulmastic paint for protection against atmospheric corrosion and possible gasket leaks.

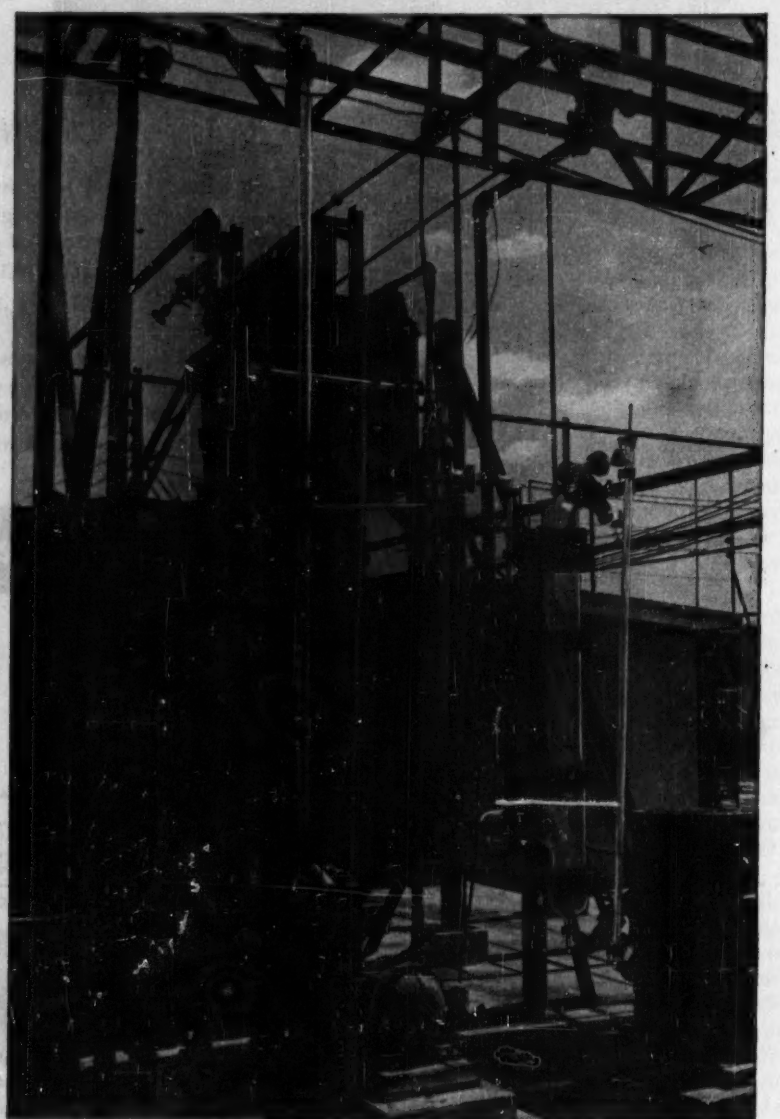
Chemical Products Corporation is one of hundreds of chemical companies that have found the most satisfactory answer to such severe pipeline corrosion problems by installing PYREX brand glass pipe. If you have stubborn problems of this nature, the information on the next page may interest you. Mail the coupon today for more detailed information.

A portion of the 450-foot bridge which carries the PYREX *pipeline from condenser storage to processing storage 600 feet away. (The last 150 feet of the line is on ground-level supports.)* The severity of the corrosion problem involved in this liquid handling is due to traces of organics remaining in the HCl.



Midway in its descent from the bridge to the ground level supports, the PYREX *line carries a valve and hose for unloading tank cars and tank trucks when necessary.*

The final turn of the long PYREX *pipeline discharges the HCl solution into three 1,000-gallon tanks. (The picture shows a corner of one of them.) Much of the credit for Chemical Products Corporation's trouble-free experience with this* PYREX *pipe installation is due to a well designed system of supports for the line.*



System of PYREX *pipe which serves the plant-assembled* PYREX *gravity separator (visible at right of above picture) where hydrochloric acid is separated from organic liquids carried over from a benzene-chlorine reaction. The pump in the foreground pumps the acid through the long pipeline shown in the other pictures.*

a severe acid handling problem

This pipe ends corrosion problems

Recent years have seen a remarkable increase in appreciation of the fact that the characteristics which dictate the choice of glass in laboratory applications, apply equally well to the handling of corrosive or sensitive fluids in industrial processes.

PYREX brand "Double-Tough" glass pipe, designed for fullscale production operations and doubled in strength by end-tempering, has repaid its cost many fold in a great variety of chemical handling operations.

Remarkable corrosion resistance reduces pipeline replacements

The story of the Chemical Products Corporation's PYREX pipe experience, on the opposite page, demonstrates one of the common advantages:—*elimination of periodic replacements of pipeline because of acid corrosion.*

Other advantages

Non-Contamination—Most materials will not stick to the smooth, hard surface of PYREX pipe. Surface deposits either do not build up or are easily removed. It is simple to clean and sterilize. It neither gives nor picks up any measurable taint of color, taste or odor.

Transparency—Where it is important to see the flow of material in a pipeline, the clear transparency of PYREX pipe is essential. Visual demonstration of internal cleanliness is often desirable.

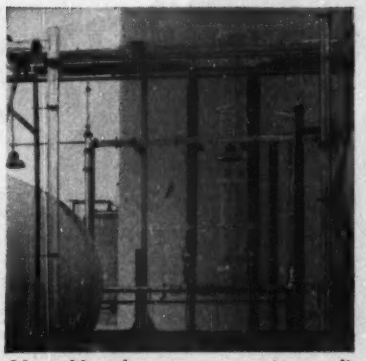
Operating temperatures—PYREX brand piping is operating satisfactorily in outdoor installations with temperatures of less than 0° F., and in indoor installations with liquids at temperatures as high as 250° F., and higher in special cases.

Installation—PYREX pipe is easy to install and low in installed cost compared with other corrosion-resistant materials. It is available in six standard sizes from 1- to 6-inch I. D., inclusive.

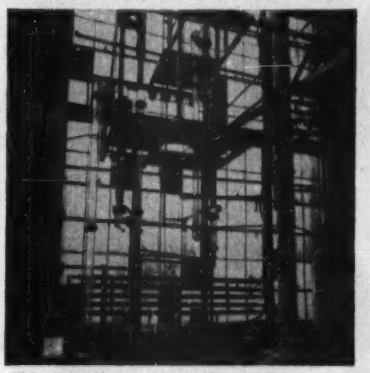
Detailed information yours for the asking

Since it is to your advantage to weigh the inherent and relative advantages against the disadvantages of any pipeline material before making an installation, we invite you to discuss your particular problem with a PYREX pipe representative at your convenience.

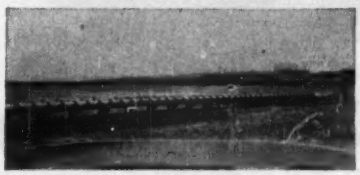
Meanwhile, the literature listed on the return coupon at right will give you many more facts than there is room for here. Just check the items you would like to receive, fill out the coupon and we will act promptly upon its receipt.



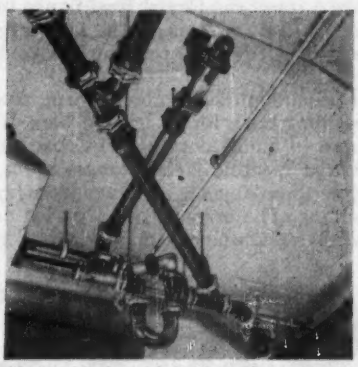
Monochloro benzene — operating conditions 230° F. at 30 p.s.i.



Chlorinated organic compounds



Acid fume disposal line



Hydrochloric acid, ferric acid, nitric acid drain lines

The following conveniently located distributors stock and sell PYREX pipe and fittings. Contact the one nearest you for full information.

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Glass Engineering Laboratories

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Valley Foundry & Machine Works

NEW HAVEN, CONNECTICUT
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Please send me the information checked below:

- ☐ "PYREX brand Glass Pipe in the Process Industries." (Application experience)
- ☐ "Installation Manual."
- ☐ "PYREX brand 'Double-Tough' Glass Pipe and Fittings." (New catalog)
- ☐ I want to see a PYREX pipe representative.

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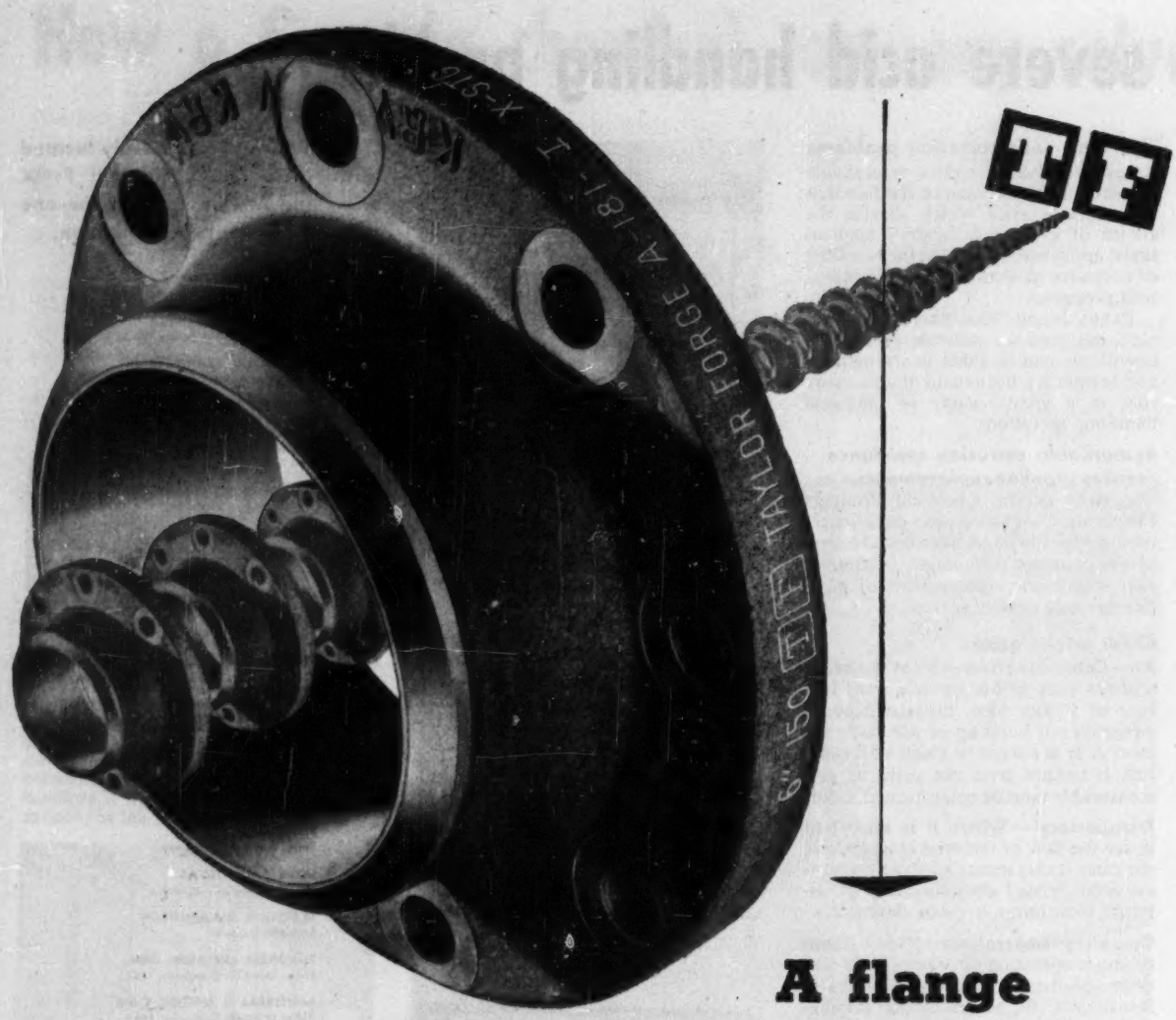
Corning means research in Glass



A flange with a background...

You are looking at a flange with a history. Taylor Forge made the forged steel flange and in a sense the forged steel flange made Taylor Forge. It was Taylor Forge, back in 1905, who made the first forged steel flanges on a commercial scale . . . and it is Taylor Forge who has guided flange development across the past half century.

Through the first threaded flange form, the bolted Van Stone form, and the perfected welding neck form pictured here, Taylor Forge has undeniably contributed more to flange development than any other organization*.

Taylor Forge Welding Neck Flanges are a part of the WeldELL® line—the line that more than 20 years ago gave industry the first complete line of fittings for pipe welding. The organization that led development is still leading . . . in scope of types, sizes, weights, materials . . . in quality and downright value!

For up-to-the-minute facts see your Taylor Forge Distributor

TAYLOR FORGE

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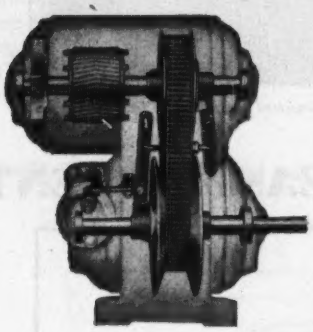
Plants at: Carnegie, Pa., Fontana, Calif., Gary, Ind., Hamilton, Ont., Canada

* When pressures rose from the old 150- and 300-pound standards to 400, 600 and finally 900 pounds, it was largely the exhaustive research of Taylor Forge that supplied the formulas for determining stresses in flanges for any given condition of loading. Among many examples: the Taylor-Waters formula, published in 1927, became and still is the basis of recognized practice for flanges in sizes through 24". Again, in 1938 Taylor Forge published the first edition of the now authoritative "Modern Flange Design" based on methods proposed by E. O. Waters, D. B. Rossheim, D. B. Wesstrom and F. S. G. Williams, Taylor Forge Manager of Engineering Standards. (ASME Trans., Apr. 1937)

Proportioning With Speed-Trol Boosts Output 25%

Simpler, more accurate regulation of acid-seed proportion in delinting cotton seed accomplished with Speed-Trol variable speed drive increased production 25%, improved quality and reduced costs, reports Joseph J. Day, California Acid Delinting Co., Visalia, California. With our processed cotton seed, growers require 65% less seed per acre and also eliminate chopping.

STERLING SPEED-TROL



OUTSTANDING FEATURES:

Infinite speeds—positive speed regulation—fingertip control—large indicator—positive pulleys—no springs—belt tension in proportion to load—protected—streamlined—Herringbone Rotor—through ventilation—versatile mounting—NEMA dimensions—shock absorbing—quiet operation—rugged—compact—dependable—long life.

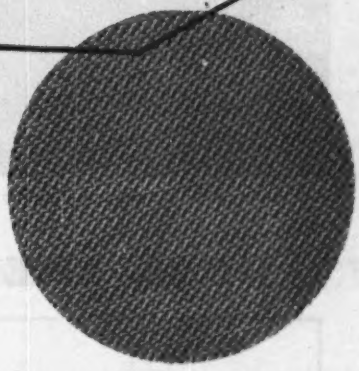
20-page illustrated catalog... Sterling Speed-Trol, Slo-Speed, Klosd and Klosd-Tite Electric Power Drives. Write for catalog No. B-412.

STERLING
ELECTRIC MOTORS

Plants: New York City 51; Van Wert, Ohio; Los Angeles 22; Hamilton, Canada; Santiago, Chile
Offices and distributors in all principal cities

Need a STRONG Filter Cloth?

You NEED NYLON!



NYLON, you know, has the highest tensile strength of all fibers—natural and synthetic—and keeps this strength under severe working conditions. And, NYLON is outstandingly resistant to flex and abrasion wear, which makes for strong, long-lasting fabrics. NYLON is outstanding in many other ways, too. Check these NYLON advantages:

Highly resistant — to most common alkalies, common organic acids, many other chemicals.

Stands up well — under heat: maximum working temp. 250°F., outshines all other synthetics in the 200-250° range.

Unaffected — by fungi, molds and bacteria. Where contamination is a factor, such as in filtering food products, pharmaceuticals, etc., NYLON may be steam sterilized, making it ideal for the job.

Promotes — easy cake discharge because NYLON offers a smooth non-clinging surface.

We can supply you with NYLON filter cloth in many weaves, in many widths, in roll lengths or less, or as prepared filter element covers sewed with NYLON thread.

Write us for test samples — when you do, tell us about your filtering problem.

Weavers of Industrial Filter Media for over Forty Years

The National Filter Media Corp.

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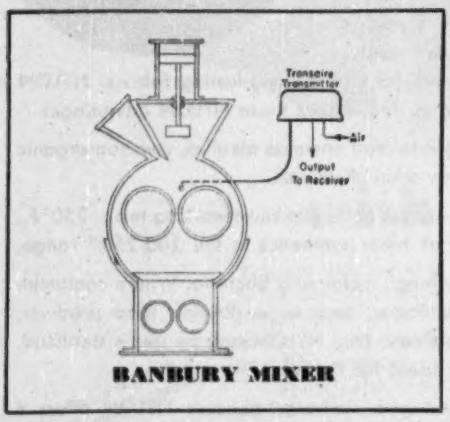
To measure *dynamic*

Accurate measurement of dynamic temperatures in Banbury Mixer has made automatic control feasible and profitable.

HERE ARE FOUR TOUGH MEASUREMENT



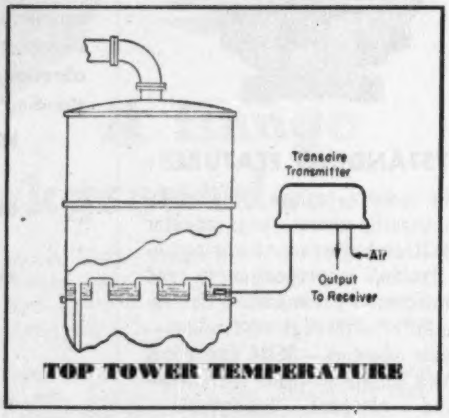
BANBURY MIXER

Compensates for Poor Heat Transfer of Mix

Problem: Poor heat transfer of the rubber compounds in a Banbury Mixer makes it difficult to closely measure the mechanical heat generated. Excessive heat causes deterioration of ingredients—and a very real fire hazard.

Solution: TRANSAIRE Temperature Transmitter, with derivative action (SPEED-ACT) in the measuring system, compensate for both the poor heat conductivity of the mix and the inherent thermal lag of the rugged separable well required. The cigarette-size bulb permits its ideal location, and aids the speed of response, as of course does the THERMOSPEED sleeve in the separable well.

Results: An accurate record of the true *dynamic temperatures* of the mix and the *time* of every batch. Another dividend: the process can now be put under automatic control (see photograph above)—never before feasible.



TOP TOWER TEMPERATURE

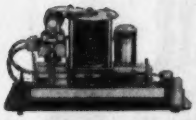
Short Range Span Detects Temperature Trends

Problem: To get highest possible purity of product consistent with good production economy. This requires the quick detection of temperature trends over a very narrow range.

Solution: The short, shiftable range spans (as short as 50°F.) for the TRANSAIRE Temperature Transmitter permit selection of operating range by a simple screwdriver adjustment. SPEED-ACT feature assures detection of temperature change of less than 1/10 of 1% of span and is accurate to ½% of span.

Results: Close control because the minute temperature trends are practically instantaneously detected and transmitted to the controller and receiver. This means higher yield of a purer product, also great flexibility in changing to different product requirements.

temperatures you need DYNAMIC ACCURACY



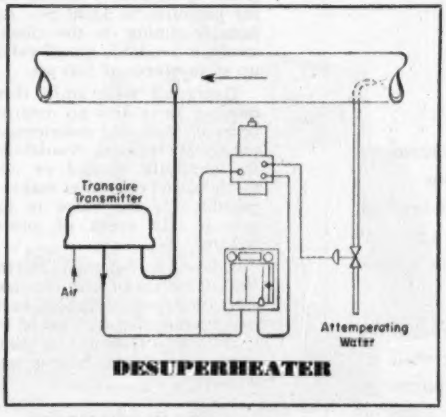
Dynamic Accuracy, (the accuracy of an instrument in measuring changing or *dynamic* conditions), reaches a new high in the Taylor TRANSAIRE* Temperature Transmitter. This instrument solves the problem of many process engineers who realize that an instrument, accurate to a fraction of a degree in measuring static conditions, can easily be in error by a great many degrees when the temperature is changing. It operates on the force-balance principle, pneumatically transmitting temperature as far as 1000 ft. with an extremely high degree of accuracy. And its standard output pressure range of 3-15 psi means that no special calibration of receivers is necessary.

This ability to accurately measure changing temperature is due to the low heat capacity of the cigarette-size bulb and dynamic compensation, i.e. compensation for inherent lags both in the measuring system and in the rate of heat transfer of the process medium. It is achieved by the introduction of derivative action (SPEED-ACT*) in the measuring circuit.

Not only does this new accuracy reveal previously unknown temperature conditions in a process, but this hitherto unattainable speed of response has a profound effect on the results obtainable when temperature is automatically controlled.

Ask your Taylor Field Engineer or write for **Bulletin 98097.** Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

PROBLEMS SOLVED BY DYNAMIC ACCURACY



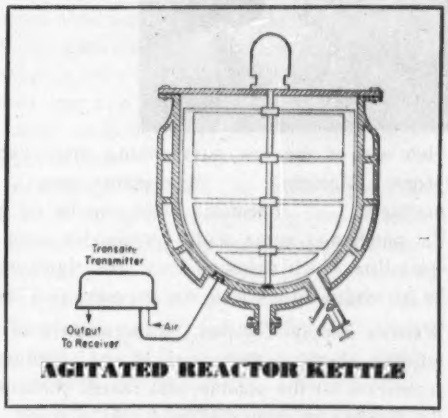
DESUPERHEATER

Fast Speed of Response Catches Rapid Temperature Changes

Problem: Steam at high temperature, as with any gas temperature measuring problem, has poor heat transfer characteristics, making it difficult to measure dynamic temperatures.

Solution: The low heat capacity of the cigarette-size bulb (made possible by the force-balance system), and SPEED-ACT compentsation for the rugged well required, give unprecedented speed of response to temperature changes under these adverse conditions.

Results: Smooth efficient operation, and greater protection to expensive equipment in subsequent processing steps.



AGITATED REACTOR KETTLE

Small, Flat, Flush Bulb Clears Scraper

Problem: Close temperature measurement and control in a jacketed vessel, requiring scraping agitation, for which conventional measuring devices have proven impractical.

Solution: Small, flat temperature sensitive bulb installed flush with the inside wall of the vessel. SPEED-ACT derivative action in the measuring system to compensate for poor heat transfer.

Results: Closer temperature measurement and control; the use of standard agitating equipment without modification; uniformly high yield in all kettle areas—the difference between satisfactory and unsatisfactory operation.

*Trade-Mark

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

The *Purchasing Agent* Has Many HANDS

He's one of the few guys around that's expected to be a crowd of people. Engineer . . . maintenance man . . . superintendent . . . machinist . . . operator. There can be no gaps in the know-how of the purchasing agent, so he recruits his extra hands from the corps of specialists which surround him. His signature on the check is backed by his ability to correlate the experience of many men.

Western Supply Company, manufacturers of heat exchangers for the refining, chemical, petrochemical and pipeline industries, has staked its reputation on the accurate and honest presentation of its equipment to the purchasing agent's advisors. As a result, plant men have come to rely on Western's integrity in the designing and building of all types of heat transfer equipment for all types of heat and pressure services.

Sales are often *made by talking.*

Confidence comes only through *experience.*

Purchasing agents throughout the world turn with *confidence* to Western for all their heat exchanger needs.

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HEAT EXCHANGERS

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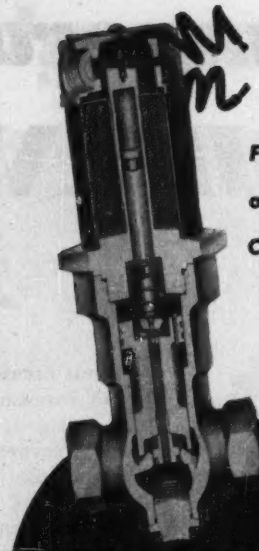

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Atkomatic Solenoid Electric Valves are made with standard coils of paper insulation, vacuum impregnated and baked for resistance to moisture, or glass-insulated coils for higher temperatures.

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ELECTRIC VALVES

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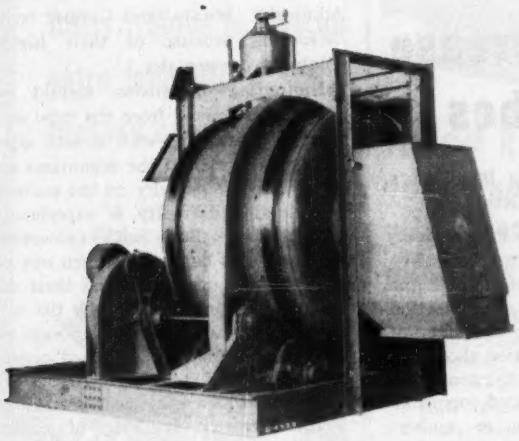

THE MODERN WORTHINGTON CHEMICAL MIXER is available in sizes up to 110 cu ft or 3 tons per batch. Each mixer is equipped with a measuring tank for various chemical applications.

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Industrial Mixers

But it isn't *that* bad, friend. Give us a chance to help. We've got a mixer that can boost your daily output as much as 10 per cent. It's the Worthington chemical mixer with an engineered blade design that gives you a mixing action faster than any we know of. It saves time with every batch, can be set up for continuous agitation, mixes thoroughly, and eliminates these other big problems as well:

CORRODED DISCHARGE CHUTE—The Worthington discharge chute is out of the mixer during mixing time. Proper balance makes manual control of chute easy. Pneumatic controls are also available.

WOBBLY DRUM ROLLER—Worthington drum rollers are of genuine carwheel metal, ground to close tolerances. Drum roller shafts are easily adjustable to compensate for wear.

HEAVY HORSEPOWER CONSUMPTION — Worthington's specially engineered, anti-friction construction assures peak operating efficiency with lowest possible horsepower consumption.

SEND THIS COUPON TODAY to learn more about how to reduce mixing time and cost with a Worthington chemical mixer. There's a skilled Worthington engineer near your plant. At your request, he'll be glad to call on you.

Worthington Corporation
Industrial Mixer Division
Plainfield, New Jersey

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☐ I'd like more information. ☐ I'd like to talk with an engineer.

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CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

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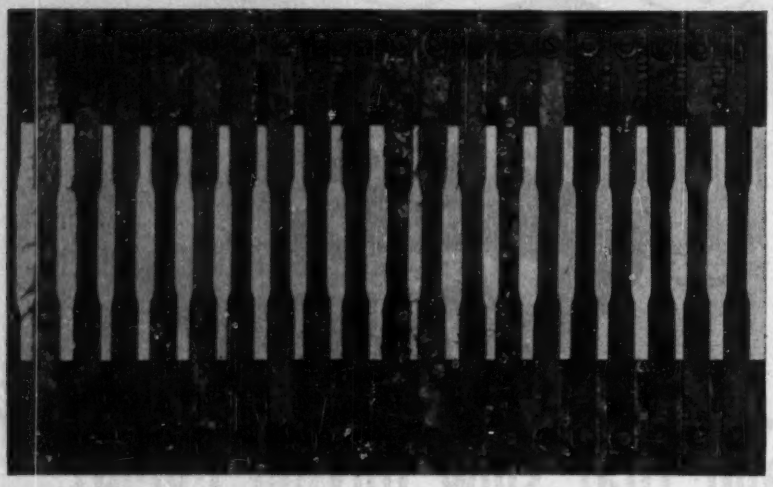

How various copper alloys respond toward biofouling in harbor water. The most corrosion resistant are the most affected by biofouling because of their solubility in sea water. This makes them less toxic to marine organisms, because their surfaces do not have a sufficient concentration of copper salts.

Good Cleaning Practices Increase Efficiency and Life of Tubes

The accumulation of foreign matter, such as slime, biofouling organisms, silt, cinders, and trash, lodging in condenser tubes, affect heat transfer and may lead to accelerated corrosion.

The problem of cleaning condenser and heat exchanger tubes and keeping them clean varies considerably from one plant to another.

In some plants rubber plugs have been found very satisfactory. The proper type and size depend upon the character of the silt or film to be removed. Rubber plugs, brushes, or scrapers usually are shot through the tubes by compressed air and water. The dumbbell type plug which has two wiping surfaces is quite popular.

Occasionally the cleaning implements are stopped by debris which may require "rodding." The best way to prevent debris from entering the tubes is by the proper use of strainers and screens.

Obstinate scales can often be dissolved by either inhibited acids or strong alkaline solutions which do not attack the tube itself. Chemical cleaning will be discussed in detail in a future Copper Alloy Bulletin.

Chlorination for Slime Prevention

A properly set up schedule of chlorination is very satisfactory for slime prevention. The chlorine concentration required varies with the character of the water. Over-chlorination should be avoided as it may injure the protective film and lead to accelerated corrosion. Generally, a red-brown or amber-colored film forms on the tube surface when the chlorination practice is satisfactory. This type of film is repeatedly found on tubes giving excellent results.

Excessive Chlorination Harmful

The resistance to corrosion from chlorinated waters varies with the alloy. Arsenical Admiralty (copper 70%, tin 1%, arsenic 0.03%, zinc remainder) and Muntz (copper 62%, zinc remainder) are not affected by mild chlorine solutions but may be severely attacked by strong ones. Aluminum Brass (copper 77%, aluminum 2%, arsenic 0.02%, zinc remainder) and Duronze IV, Aluminum Bronze (copper 94.25%, aluminum 5.5%, arsenic 0.25%) and the Cupro Nickel alloys are more resistant to chlorine solutions than the previously mentioned condenser tube alloys.

Biofouling Versus Corrosion Resistance

Biofouling of condenser tubes is associated with slowly moving sea water. In general, biofouling increases with the decrease in corrosion rate. Consequently, the high corrosion resisting alloys such as 70-30 Cupro Nickel (containing approximately 0.5% iron), Aluminum Brass and Durozone IV are highly susceptible to biofouling because of their low rates of solubility in sea water. The water film adjacent to the metal surface does not contain a sufficient concentration of copper salts to be toxic to marine organisms. Admiralty, Muntz, and Copper resist biofouling because of their higher solubility in sea water.

Biofouling organisms should be promptly removed from the tube surface by scrubbing with a stiff fiber brush and water. If the organisms are allowed to die and dry on the surface, considerable difficulty is experienced in removing those with calcareous bases such as barnacles. When not removed, such organisms and their decomposition products destroy the corrosion film and act as focal points for corrosion pitting. Decomposed organisms can lead to the formation of ammonia which may be followed by stress corrosion cracking of copper alloys with high zinc content.

Operation at a water velocity high enough to prevent organisms from attaching themselves is often helpful.

Technical Service Available

If you are contemplating retubing or are planning for new installations of condenser or heat exchanger tubing, consult the nearest Bridgeport sales office for technical help in selecting the alloy which will serve best for your particular operating conditions. Write on Company stationery for a copy of the 156-page Condenser and Heat Exchanger Tube Handbook. (965)

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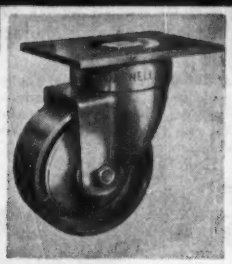

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An 85 Foot Example!

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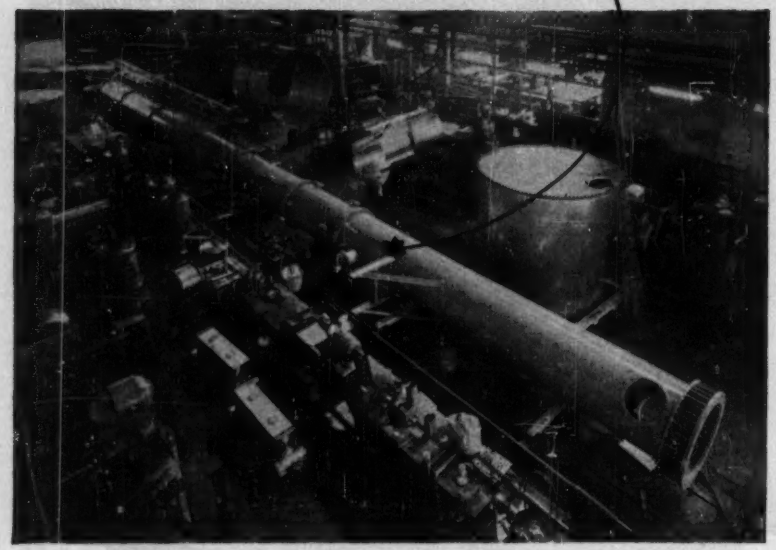

You're looking at an 85 foot column destined to handle a key distillation step in an important processing plant. Our engineers helped in the design and all of the fabrication was done in our own shop.

This is the kind of work we are doing for companies who need special process equipment. We are in position to help in the design as we did for this long column, bringing to the problems involved many years of experience in design and a good understanding of processing steps. Or, if only fabrication is desired, we call attention to our modern, well-equipped shop and skilled workmen, long experienced in handling copper, stainless steel, aluminum, carbon, silver, nickel, inconel, brass, bronze and all other commercially used metals.

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Meet the WORLD'S SIMPLEST INSTRUMENT SYSTEM!

It's Bristol's new METAGRAPHIC pneumatic transmission instrument system, for measuring, indicating, recording and controlling pressure, temperature, vacuum, flow, differential pressure and liquid level.

HERE ARE THE BIG ADVANTAGES OF THE NEW METAGRAPHIC SYSTEM:

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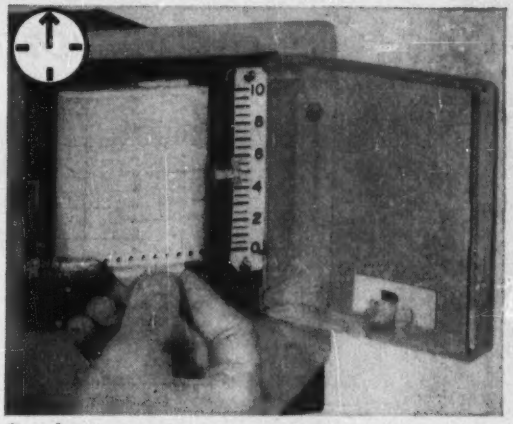
2. FLEXIBILITY – units can be combined like building blocks to make any kind of arrangement.

3. TRUE PLUG-IN SERVICE—results in great savings in installation costs; units can be plugged in or out without stopping process or control.

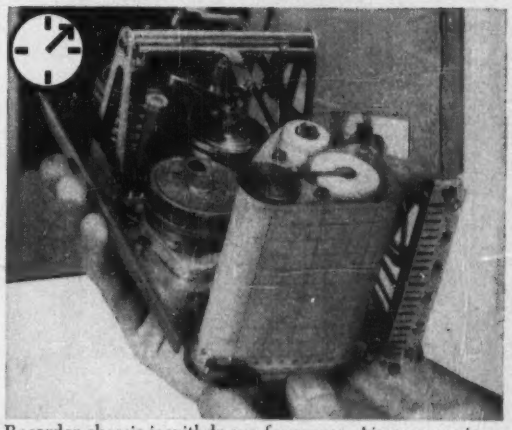
4. NO TIME LAGS—in a four-pipe circuit the transmitter signal and controller-output signal travel around a short loop—as small as three feet.

Get the whole METAGRAPHIC story by writing to The Bristol Company, 109 Bristol Road, Waterbury 20, Conn.

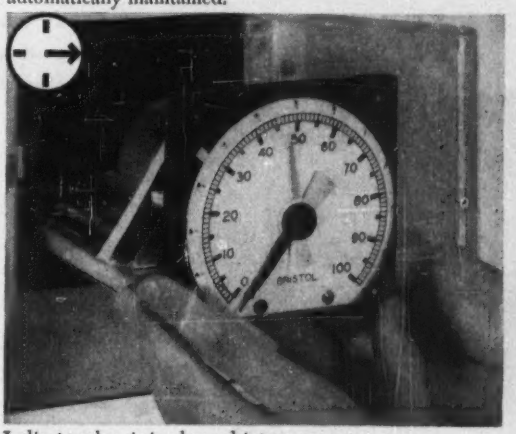
***It takes only fifteen seconds to* change the Bristol METAGRAPHIC recorder to an indicator!**



Case door is opened.



Recorder chassis is withdrawn from case. Air pressure is automatically maintained.



Indicator chassis is plugged into same case.

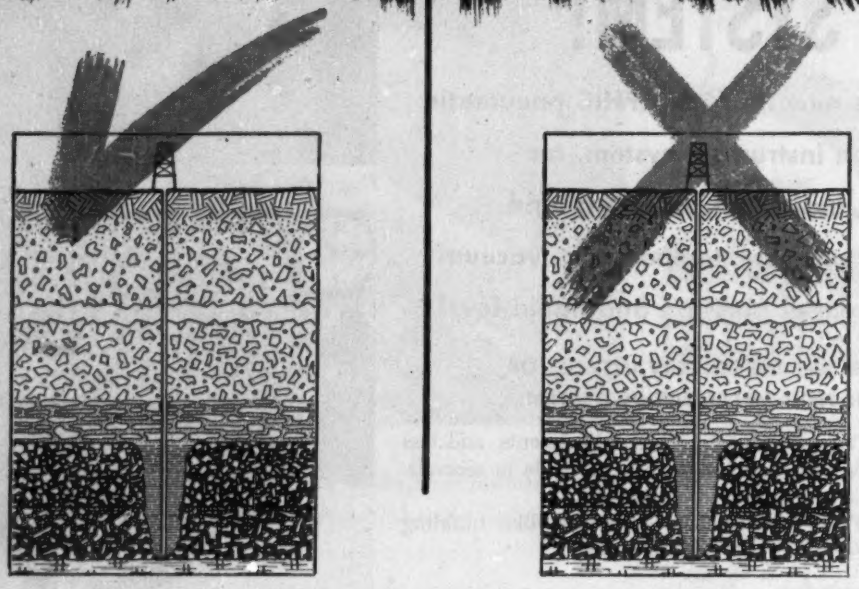
LOOK FOR OUTSTANDING NEW DEVELOPMENTS FROM BRISTOL

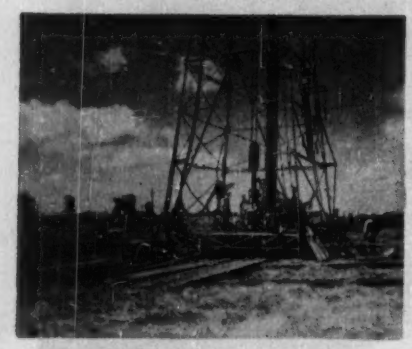
BRISTOL *THE DEPENDABLE GUIDEPOST OF INDUSTRY*

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS

SULPHUR

...why can't *Every* dome produce sulphur?





The production of sulphur in the Gulf Coastal Region of Louisiana and Texas by the Frasch Process, is from underground natural beds found in "domes." However, very few domes have been found to contain sufficient sulphur, if any, to be brought into production.

It is estimated that nearly 200 dome structures along the Coast of the Gulf of Mexico have been investigated over the last half-century but only fourteen have produced sulphur in quantity.

And the presence of sulphur, even in quantity, doesn't always mean a successful producer. Some years ago a dome was found, explored, and proved with the result that a plant for the production of sulphur was erected at a cost of several million dollars. Later it had to be abandoned because the underground conditions did not lend themselves to the use of the Frasch Process.

A dome is a sulphur mine only when it can be worked economically and produce sulphur in commercial quantities.

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SCHLUMBERGER BENEFITS:

1. When lowering equipment, suddenly decreased tension indicates a hang-up of equipment in the hole. Saves time—insures accurate records.
2. While in the hole, a continuous rough indication of cable and tool weight gives the operator an additional protective check for smoothness of his survey operation.
3. When pulling equipment up, suddenly increased tension indicates equipment caught in the hole, allowing correction to avoid cable breakage and losing or damaging expensive instruments. Saves time—saves money.
4. In field use, corrosive conditions and rough treatment are easily withstood by this Baldwin SR-4 unit. Avoids costly down time.

Baldwin SR-4 devices have uses unlimited in industry—measuring load, fluid pressure, or torque economically, speedily, and accurately. For the latest technical information please write to Department 3304, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.

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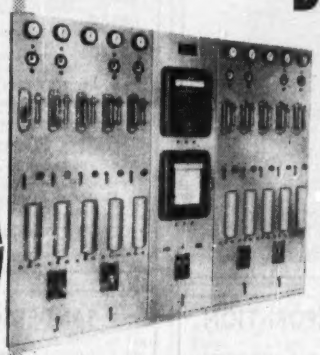

The finest CO safeguard in the world. Operates continuously without supervision. Accurately detects CO in all ranges, and in concentrations as small as 0.05 parts CO in 10,000 parts of air. Can automatically control ventilation systems and reduce power waste by turning on fans **only** when needed, turning them off when danger is past. Designed for long periods of trouble free, heavy duty operation.

2 TALLER & COOPER'S PORTOCO

A small, compact unit for protection in enclosed areas. May be moved from place to place to spot-check CO concentrations, or operated continuously at a permanent location. Indicates when and where fans should be turned on. Can also automatically control fans. Offers the highest dependability and accuracy at the lowest cost.

With slight modifications can be used to safeguard against combustible and explosive gases.

Write for Bulletin 203 and full details.

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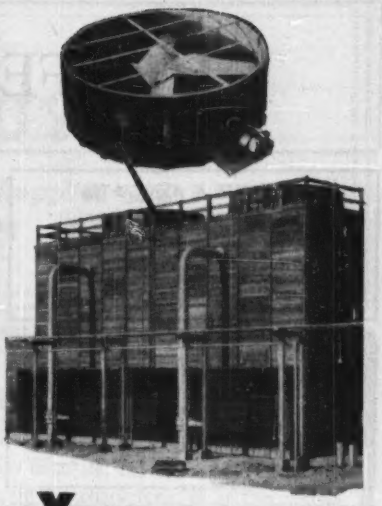

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(Continued on page 468)

Additional Employment & Business Opportunity Advertising on page 468.

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(Continued from page 466)

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1—Abbe #2 Blutergess Sifter.
100'—12" Stainless Steel Screw Conveyor.
8—Bucket Elevators, steel housing 34' to 60' centers, 8"x5", 10"x6" buckets.

MIXERS

1—Baker Perkins JUMM jcktd. double arm, dispersion blades, 100 HP.
3—Baker Perkins 50 and 100 gal. Sigma Blades, jcktd.
2—Baker Perkins, Day, 35 and 50 gal. SS jcktd.
1—#1A Banbury.
1—Patterson 4' dia. Conical, steel.
1—Robinson 4000# steel powder.
6—Rodgers 400 to 3000# powder.
8—New Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gal. Pony.

KETTLES—STILLS CONDENSERS—TANKS

5—Pfaudler Reactors glass-lined 2000, 1500, 1000, 750, 500 gal.
6—Buflovak, Zaremba and Kilby Evaporators 300 to 14,000 sq. ft.
1—Lummus 4' dia. Steel Bubble Cap Column.
1—4' dia. Bubble Cap Column, copper and stainless.
8—Heat Exchangers, SS 50 to 570 sq. ft.
5—Buflovak Condensers 20 to 90 sq. ft.
3—Groen 125 gal. SS, jcktd., agitated Kettles.
1—2800 gal. 316 SS Tank with coils.
3—2300 and 1400 gal. Aluminum Tanks.
6—Glass-lined Storage Tanks 6000 and 8000 gals.

MISCELLANEOUS

7—Stokes Vacuum Pumps 10 to 100 CFM.
8—Stokes DD2, BB2, D4, D3 and B2, Rotary Tablet Machines.
5—Nash TS12, TS8, L3, AL672, #4 Vacuum Pumps.
4—Olivite, Duriron rubber and stainless steel Centrifugal pumps 6" to 1".

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LATEST OFFERINGS FROM THE FMC STOCK

3853 S 2—Two Vertical Type 316 Stainless Processing Kettles; 1200 gal. 6' x 5'10½" plus 9" cone bottom with coils and slow speed agitators

3705 L7—Stainless Lab. Autoclave; 5" x 12" agitated

3662 D28-31—Two Stainless Jacketed Reactors 18" x 18"

3549—Stainless Jacketed Autoclave 10" x 15" 3000 PSI; with anchor agitator

3824 S 12—Pfaudler Glass Lined Reactor; Jacketed 12" x 12" with anchor agitator

3424 K 11—Type 316 Stainless Closed Head Receiver; 38" x 42"

3798 V 1—Lancaster Rotary Digester or Reactor; stainless lined; 1000 gal. 64" x 19'; jacketed 300 PSI

3781—Sprout Waldron Stainless Continuous Cylindrical Mixer; 28" diameter x 12' long with heavy ribbons

3673 L39-40—Two American Sterilizers 42" x 60" quick opening doors

3803—Climax Rectangular Sterilizer or Disinfectant; 48" x 42" x 8' complete

3793—Rex Stainless Steel Heat Exchanger 20' long having 36 tubes 1"

T 6-800—16 A. O. Smith Glass Lined Horizontal Tanks; 7'4" x 28' long and 34'8" long

3659 B 3—Aluminum Bubble Cap Column; 27½" x 36'; 11 sections; 60 plates

3470—Stainless Bubble Cap Column 8-3/8" x 19' high; 16 sections complete

3274—Swenson Quadruple Effect Long Tube Vertical Film Type Evaporator may be separated for single or multiple use; print available

10595—Louisville Rotary Steam Tube Dryer Type "T" 54" x 40' long with 38" x 20' Carrier

3316—Bagley & Sewell Double Drum Dryer; 28" x 60"

655 R 6—General American Twin Drum Dryer 42" x 120" complete

3501/E3—Devine Vacuum Chamber Dryer No. 12; accommodates 20 shelves 40" x 43"

1152 M—Bird 12" Rubber and Lead Lined Lab. Centrifuge; motor-ized

3853 S3—Baker Perkins Ter-Meer Type Continuous Centrifuge Size S12 in Type 316 Stainless complete with Slurry Feeder

3853 S10—Tolhurst Stainless 40" Suspended Type Centrifugal Extractor with 2 speed motor

3497 S 3—Tolhurst Everdur 40" Suspended Type Centrifugal Extractor with 2 speed motor

1153—Two Bird 48" Suspended Type Rubber covered Centrifuge with 2 speed motor

3615 G1—Tolhurst Overdriven Suspended Rubber Covered Centrifugal 48" x 25" with 2 speed motor

SPECIAL OFFERINGS

11 Shriver Cast Iron Filter Presses 32" x 32" 48 Chambers; washing type; open delivery; many extra parts; crated for export

14 Patterson and International Pebble Mills; 6' x 5'; 6' x 8' and 8' x 8'

16 W. & P. Type Jacketed Heavy Duty Double Arm Mixers; 100 gal. and 150 gal. working Caps

6 Sperry Aluminum Filter Press; 18", 30" and 36" in excellent condition

17 New and Unused Stainless Steel Tanks with agitators; 1000 gal. and 2000 gal. at great reductions below today's market prices

20 Hammer Mills by Mikro, Gruendler, Fitzpatrick, Williams, Jeffrey, Sturtevant, Robinson, etc.

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3—Autoclaves, 110 Gal. Chrome Vanadium, Jack. 2000# W. P.
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1—Read 100 Gal. D.A. Jack. Mixer—40 H.P.
1—B.P. 20 Gal. D.A. Jack. Mixer.
1—Micro 2TH Pulv. 15 H.P.
1—Simpson #2 Intensive Mixer.
1—Komerak Greaves Briquette Machine.
1—Raymond #47 Imp. Mill 50 H.P.
1—PF 250 Gal. C.L. Vac. Receiver.
1—S.S. Condenser 370 sq. ft.
1—Bird 48" S.S. Sus. Style Extractor.
4—Vac. Shelf Dryers, 6, 10, 13, & 17 shelves.
1—Buflovak 6' Jack. Vac. Crystallizer.
1—Pfaudler 500 gal. Reactor.
7—S.S. Jack Kettles 100 to 300 Gals.
1—Horiz. Stainless Tank, 2,450 Gals.
1—Horiz. Stainless Tank 16,000 Gals.
2—Roball Screens 40" x 120"—1 & 3 deck.
3—Bubble Cap. Columns Alum. 27" x 36".
1—Day 10 Gal. Vac. Mixer, Jack. D.A.
6—Horiz. Spiral Mixers 200 to 2000#.
4—Vert. Closed 3500 Gal. Rubber Lined Tanks.

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#316 Stainless Steel Tanks, new 100, 200 & 300 gal.
1—Stainless Tank #430 Chrome, vert. 7'x10' deep.
20—Jacketed Kettles—Stainless, Copper, Aluminum.
1—Day Mixer, steam jacketed, 50 gal. Sigma Blade.
1—Robbins Vibrex 3x6 Vibrating Screen, single deck.
1—Copper Evaporator, steam jacketed, 9'1"x3'9".
60—New Pressure Cookers, 18"x18" & 24"x28".
50—Pumps—steam and electric.
1—New Glass Nash Centrifugal Pump, 100 gpm.
1—Jeffrey Vibrating Conveyor 15' lg. 12" wide.
1—Buflovak Jacketed Impregnating Tank 42"x52".
1—4x6 Sturtevant Jaw Crusher.
1—Ribbon type Mixer, steam jacketed.
1—Model 16 Sharples Stainless Steel Centrifuge.
3—New Drum Rollers.
2—Nash Air Compressors, Type AL-623.
1—Manton Gaulin Stainless Homogenizer 125 gph.
3—French Oil Mill Lard Cookers.
1—Shriver 18 Aluminum Filter 9-plates 9-frames.
1—Rotary Dryer direct fired 54"x30'6".
10—New Sharples Oil Purifiers.
1—#316 Stainless Reactor, 265 gals. cap., jacketed.
Mead Mill #2 with 7½ HP motor & Drawer Feeder.
Davenport Rotary Steam Tube Dryer, 6'x36'.
Abbe Pebble & Tube Mill, 5'x22'—Burr-Stone Lined.
1—Patterson Ball Mill, steam jacketed, 36"x42".
1—Patterson Ball Mill, porcelain lined, 17"x27".
3—Dopp Kettles with agitators, 600 gal. cap.
1—Ribbon Type Mixer 30" dia. 10' lg. center discharge.
2—Large Steam Jacketed Horizontal Mixers.
Robinson Pulverizer 2'10, with 2 motors 10 HP each.
Robinson Ribbon Type Mixer, 30"x10'—like new.
6—Steam Jacketed Blackburn-Smith Filters.
2—Crystallizers—10' long.
2—500 ton Hydraulic Presses.
3—3,000 gal. Jacketed Kettles with Turbo Agitators.
1—300 gal. Double Arm Mixer—jacketed.

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10 Cold water deaerators, rubber lined, never used, 3,000 Gal. per minute. Tanks are 11' by 56', built for pressure and vacuum, price $11,000, F.O.B. cars.

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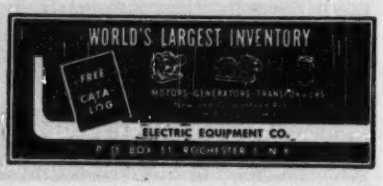

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COLUMNS—STILLS

1—Bubble Cap Column, High Chrome Iron, 64" dia. x 13 plates.

3—Baffle Plate or Cascade Columns or Towers, T304 stainless steel, 5' dia. x 50' high.

2—Sections 6' dia. St. St. Baffle Plate Column.

3—Aluminum Bubble Cap Columns, 36" dia. x 45 plate; 27" dia. x 18 plate

1—Aluminum Perforated Plate Column. 28" dia. x 36 plate.

1—Copper Column with 18—30" dia. perforated plates and 10—24" dia. bubble cap plates.

CONDENSERS—EXCHANGERS

1—St. St. Single Pipe Cooler, 2" pipe, 800 ft.

3—St. St. Double Pipe Coolers—73 & 78 sq. ft.

15—Alum. Coil Exch. 47 sq. ft.

7—Copper tub. 65, 90, 140, 1350 sq. ft.

7—S.S. tubular exchangers 14, 55, 70, 160, 368 & 400 sq. ft.

1—Steel Shell & Tube, 1000 sq. ft.

3—S.S. Coil Condensers, 40 & 55 sq. ft.

FILTERS

1—Alsop St. St. SD-12-WR-30.

3—Adams T304 St. St. Single Tube, #WJR-1.

2—International T304 St. St., #3 (24" dia.) and #5 (33" dia.)

1—Sweetland #10, 21 leaves, 3½".

1—Sweetland #12, 72 leaves, 2".

1—Swenson Rotary Continuous Vacuum Filter; Precoat type, 8' dia. x 8' face. rubber covered and lead acid proof.

1—FEINC Aluminum Rotary Vacuum string discharge, 4'6" dia. x 6'.

4—Pressure Leaf Filters, 70 to 140 sq. ft.

1—Shriver 36" Filter Press, rubber covered, closed delivery.

1—Shriver 36" C. I. P&F., 20 ch. cl. dly.

1—Sperry 24" C. I. Filter Press, 16 Ch.

1—Louisville 8-roll Continuous Filter or Grains Press, 24".

JUST PURCHASED

8—4100 gal. Aluminum Tanks, Vert., closed, 5/16"

24—Lastiglas lined welded steel tanks 21,700, 13,700, 9100, 6000 and 4400 gal. sizes

2—Kennedy Van Saun Continuous Air Swept Ball Tube Mills, 3' dia. x 6' long, steel liner, steel balls.

15—Aluminum Compartment Tanks, 2700 gal. & 3000 gal., 5 comp., removed from truck chassis.

1—48" dia. Bubble Cap Column, 40 plates on 12" centers (12 T347 St. St. plates, 12 copper plates, 16 steel plates).

KETTLES—REACTORS

8—15,000 gal. Steel Reactors, with coils and 40 HP agitator.

1—450 gal. Monel Tank, ¼", with coils.

3—13 gal. Autoclaves, T347 St. St., 700# int. WP., 50# Pkt. WP.

1—St. St. T304 Pressure vessel, 18" dia. x 9'4" long, 600# W.P.

2—450 gal. Stainless Steel Kettles, Jktd. & Agit.

70—Stainless Steel and Stainless Clad open top, steam jacketed kettles—40, 60, 80, 100, 150, 500 gal. sizes.

2—300 gal. T316 Stainless Steel jacketed Tanks, 10# jkt. double motion agit.

1—200 gal. Read Stainless Steel Jacketed Kettle, double motion agit., 10 HP.

4—Aluminum Reaction Kettles, Jktd. & Agit., 35, 60, 100 gal. and 250 gal.

MILLS—PULVERIZERS

2—Kennedy Van Saun 3' x 6' Air Swept Contin. Ball Tube Mills.

1—Williams Hammer Mill type AK; size A, stainless steel.

4—Mikro Pulverizers, #1-SH, #1-SI #2-SI, #2-TH.

1—Premier Colloid Mill, 6" st. st.

1—Acme #8½A Jaw Crusher.

TANKS

35—Aluminum Tanks, closed, 4, 275, 330, 480, 500, 1350, 1450, 2300, 2700, 3000, 4100 and 9000 gal.

50—Horizontal Welded Steel Tanks from 3800 gal. to 21,700 gal. sizes.

1—Vertical Rubber Lined, 6000 gal. open.

8—15,000 gal. Vertical Welded Steel Closed Fermenting Tanks, 90 lbs. WP., turbine agitator with 40 HP motor; 970 lin. ft. 3" pipe coil. Excellent condition.

STAINLESS STEEL TANKS

3—T347 Pr. or Vac.—50 & 235 gal.

2—T316 Pr. or Vac.—35 & 160 gal.

11—T304 Pr. or Vac.—2½, 9, 150, 160 & 260 gal.

1—T304 600# pr.—86 gal.

50—Stainless Steel Storage Tanks—from 15 gal. to 16,000 gal. sizes.

1—3000 gal. Horizontal Stainless Steel Tank, 5'4" dia. x 18'9" long, insulated and agitated.

MISCELLANEOUS

1—St. St. Bin, T316, 275 cu. ft. cap.

1—AT & M Susp. 48" Centrifugal, Perf. Basket, Bottom discharge, T-304 s.s.

1—Bird Susp. Centrifugal, 48" dia. Perforated Basket, T347 St. St.

5—DeLaval Centrifuges, models #600, 74-11 and 94-01.

1—B & J #1½ Rotary Cutter, St. St.

3—Witteman Co. Atmospheric Double Drum Dryers, 22" x 38".

2—Kux Machine Co. Model 25 Rotary Pellet Presses, 21 and 25 punch.

4—Selectro Vibrating Screens, stainless steel, 2' x 7', double deck, enclosed.

1—Stokes Vertical Steel Jacketed Vacuum Chamber and Impregnating tank, 30" L x 25" W x 24" D.

2—Vertical Agitators—40 HP gearmotor with Turbo #5B drive, 70 RPM.

1—Baker-Perkins #14—JEM Universal Mixer, Jacketed, Vacuum Cover, 50 gal. work, cap., 50 HP motor.

1—Porter heavy duty jacketed double worm mixer—75 gal.

140—St. St. Flanged Gate Valves, 1", 1¼", 2", 2½" x 3".

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1—**USED EQUIPMENT IN STOCK** — TANKS — KETTLES — RECEIVERS — COLUMNS — STILLS — AGITATORS & MIXERS — CONDENSERS — HEAT EXCHANGERS — COILS — TUBING, PIPING, FITTINGS, ETC.

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1—6x40 Direct Heat
1—6x50 Louisville Steam Tube
1—Grupe 5'x22, steam tube.
2—5½'x7 & 60' Rotary Kilns.
1—4½'x32" rotary direct heat.
1—6'x35' Louisville steam tube.
1—4½'x28' Rotary Direct Heat, oil.
1—6x32' Rotary—direct heat.
1—Davenport #3A bronze rotary Press.

Centrifugals and Clarifiers

1—set 2—36" American suspended (two with stain. steel perforate basket).
1—48" Tolhurst susp. steel perf.
1—40" Tolhurst suspended rubber covered perforate basket. Also 32".
2—De Laval 54-81 Clarifiers, 3 hp.
3—Sharples airtight clarifiers, stain. steel.

Evaporators and Vacuum Pans

1—60 sq. ft. 316 SS Single Effect
1—Alberger 1500 sq. ft. SS Condenser
1—Peebles triple effect, stain. steel.
1—20 gal. Stokes st. steel Vacuum Pan.
1—Swenson sgl. eff. Evap. 120 sq.ft.
1—Swenson quad. eff. Evap., 350 sq.ft.
1—Zaremba trip. eff. Evap. 150 sq.ft.
1—Swenson trip. eff. Evap., 850 sq.ft.

Filtration Equipment

12—Cast Iron recessed and plate and frame Filter Presses, 7" to 36".
1—Aluminum 36" 40-chamber P&F. press.
1—Lead 24" 32-chamber P&F. press.
1—Oliver 8x14' Filter.
1—Oliver pressure, iron, 110 sq.ft.
5—Alsop, Lamax internal pressure Filters, stain. steel and bronze.

MILLS

2—Raymond 35" Vertical Mills.
3—Mikro Pulverizers: #1SH, 1SI.
1—Attrition, Sprout-Waldron 20".
12—Pebble and Jar Mills, 1 to 235 gal.
5—Colloid Mills and Homogenizers.
1—Raymond 5-roll high side.
10—Hammer Mills, ¾ to 50 hp.
6—3-roll Mills, Day, 12x32" and 16x40".
1—2-roll Rubber Mill, Birmingham, 12x24".

MIXERS

1—Day 1 bbl. stain. steel, single arm, jacketed, vacuum cover 3 hp.
2—Day Pony Mixers, 40 and 15 gal.
1—Abbe Lenart 5 and 110 gal.
1—Colton #6 s.s. Granulating.
1—Readco 250 gal. work. cap. stain. steel dbl. arm, 50 hp.
7—Baker-Perkins, Read, Lyan-Superior dougle arm, up to 100 gallons.
2—Day 3000# jacketed horizontal ribbon.
10—Day, Robinson Powder type, 50 to 2000#.
6—Steel Mixing Tanks, 50 to 800 gal.

TANKS

30—Stainless Steel (some with agitators) new and used, up to 10,000 gal.
2—1000 gal. steel jacketed (100 psi.) open top.

MISCELLANEOUS

Screens: Rotex, Selectro, Tyler-Hummer.
Heat Exchanger: Karbate 16.5 sq.ft.
Vacuum Pumps: Stokes 105 CFM.
Sanitary Pumps: Waukesha size 55, 100.
1—Reactor: 100 gal. s.s. jacketed, agitated.

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- Kinney Size 14-9-18 Vacuum Pump. Rebuilt
- Vulcan Complete Solvent Extraction Plant
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- Rotex #52 double deck Screen, 60" x 120"
- Baker-Perkins double arm Sigma Mixer 30 HP
- 2500 Gal closed Stain. Steel Tank with coil
- Briquetting Press, Vulcan 10-12 Tons per hour
- Eimco 9' x 8' rotary cont. Filter. Complete
- Oliver 5'4" x 8' Precoat. All iron. Complete
- Abbe-Bluteregss Turbine Sifter. 3 HP
- Abbe Disperaall Mixer. 30 HP exp proof
- DeLaval Stainless Steel ACVO Centrifuge
- Day Roller Mill 12" x 32" three roll wtr cld
- Fletcher 40" Cent. 15 HP solid steel basket
- Sweetland #12 Filter, 36 ivs on 4" centers
- Sweetland #12 Filter, 48 ivs on 3" centers
- Sharples PY-14 Super-D-Canter, S.S. new
- Oliver 8' x 10' Precoat Filter. All iron
- Buflovak 2 stage Evaporator, 5' x 12'
- Vulcan 48" diameter Still, 39 steel pits
- S.S. Heat Exchanger 36-1½" tubes 16' long
- S.S. Heat Exchanger 36-1" tubes 16' long
- Bird 18" x 28" Centrifugal cont. Steel
- 300 Gal Pfaudler Reactor 316 S.S. Jckt'd
- Pfaudler 1000 Gal XL Reactor. Agitated
- Baker-Perkins 3-24 Ter-Meer cont. Cont.
- 42" x 24' Rotary Dryer, ¼" shell

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ROTARY DRYERS & KILNS

Kilns: 4'x28', 6'x80', 7'x60', 8'x72'.
Dryers: 4'x20', 5'x35', 60"x40', 84"x60', 90"x60'.
One 4'x32' Monel Lined

MISCELLANEOUS EQUIPMENT

Hammer Mills: Jeffrey 36x24B. 75 HP Motor.
6'x15' & 7'x17' Autoclaves.
Weightometers 18", 30", 36" & 42".
12'x18' Derreo Drum Filter.
5'-3"x8'-0" Rotary Vacuum Filter.
40'x30' Dorr 3 Tray, 4 Compartment Thickener.
8x4, 6x10, 7x6 & 8x6 Ball Mills.
#1 Raymond Automatic Pulverizer.
2'x15' & 6'x22' Rake Classifiers.
20'x18' Hardinge SAR Thickener.
3x10, 4x7 & 5x14 Rod Mills.
54"x30' Akins Classifier.
Hercules Junior 3 Roll Pulverizer.
Clyde-Kuntz Continuous Hydrator.
7 Electric Air Compressors, 1300, 3100 & 8374 Ft.
135-8000 & 10,000 Gal. Tank Cars.
3—44 Ton GE Diesel Elec Locomotives.

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FOR SALE

CYLINDER AUTOCLAVES, MOLD CARS, OIL FIRED DRIERS, ACCUMULATORS, MIXERS, DUST COLLECTORS, TRANSFER CARS, BATCH BUCKETS, PAN BRUSH MACHINE, LEVELATOR JACKS

and many other pieces of important machinery and equipment necessary in the manufacture and handling of

CONCRETE, LIME, GLASS, CERAMIC, CHEMICAL, ASBESTOS & RUBBER PRODUCTS

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All of the above is offered subject to prior sale and may be inspected on the premises of the OWENS-ILLINOIS GLASS CO., Kayio Div., Sayreville, N. J. INSPECTION BY APPOINTMENT ONLY. For further information, prices, and inspection appointment, write, wire or phone.

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FOR SALE

- B & P 1 & 2.25 gal. jkt. mixers Fitzpatrick Model D S/S Mill
- Buflovak Double Drum Dryer—32" x 52" complete
- Buflovak Double Drum Dryer—32" x 72" complete
- Buflovak Double Drum Dryer—32" x 100" complete
- Mikro 2 TH Pulverizer.
- Mikro 3TH Pulverizer.
- 12" P & F Bronze Filter Press.
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Roots-Con.	36	AF	2	70
Roots-Con.	3	NS	2	76
Connersville	20 x 60	SF	2½	6040
Sutorbilt	2520	SD	3	16
Roots-Con.	22	XA	3	16
Sutorbilt	3L	SD	3	69
Roots-Con.	47	AF	3	124
Roots-Con.	59	AF	3	200
Roots-Con.	615	AF	3	366
Roots-Con.	717	AF	3	650
Connersville	10 x 15	SD	3½	890
Connersville	8 x 15	B	4	530
Roots-Con.	17B	XSB	5	40
Roots-Con.	55	XAS	5	96
Sutorbilt	3L	SD	6	31
Sutorbilt	4M	SD	6	76
Sutorbilt	5M	SD	6	115
Roots-Con.	22 x 36	HD	6	5500
Roots-Con.	53	AF	7	70
Connersville	10 x 12	HD	7	614
Sutorbilt	5H	XB	10	66
Sutorbilt	6H	XB	10	128
Roots-Con.	8 x 6	HD	10	215
Sutorbilt	10 x 11	HD	10	480

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MAKE	SIZE	H.P.	Volume c.f.m.	Static. oz.
Buffalo	4E	½	450	
Max-Premix.	1	½	95	1.60
Max-Premix.	5	¾	200	2.3
N. American.	3	1	34	3.50
Spencer	Belt drive		35	7.32
Spencer	501½	½	60	8
N. American.	308-B1-½	½	100	8
Gen. Blower.	800-¾	¾	180	8
West. Prod.	1	1	300	8
N. American.	308-D12	2	575	8
N. American.	308-D13	3	850	8
Eclipse Fuel.	6815-½	7½	1100	9
Sturtevant	No. 2	1	215	10
Fisher Furn.	F-15	1	300	10
Fisher Furn.	F-20	2	390	10
Buffalo	40	5	750	10
Buffalo	6E	7½	1650	10
Spencer	075½	½	60	12
Buffalo	5E	5	900	12
Gen. Blower.	1601	1	100	16
Spencer	1002	2	225	16
N. American.	316-C2-2	2	275	16
Spencer	1005	5	600	16
N. American.	1716-G	5	675	16
Chgo. Blower.	1607	7½	980	16
Spencer	1007-H	7½	1075	16
N. American.	1716-H	7½	1100	16
Eclipse Fuel.	6819-10	10	1200	16
Power Engrg.	2010	10	1120	20
Spencer	1203	3	335	20
Spencer	1215	15	1675	20
Ingersoll-Rd.	FS-377	85	10500	20
Ingersoll-Rd.	FS-377	150	15000	20
Ingersoll-Rd.	24C-223	3	270	24
Gen. Blower.	2425	25	2500	24

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MAKE	SIZE	TYPE	Wheel Diam.	Inlet Diam.
New York	36	ME	36	39¼
U. S. Air	36	B/C	36	37¼
Buffalo	6	LL	36¼	37¼
American	6	HS	36	37¼
Thermo Ht Fan.	60	MIH	37¼	36
Clarage	3	HV	39	40¾
U. S. Air	39	M	40	34
Bayley	7	B/C	38½	39½
Sturtevant	8½	Des. 6	39¾	40½
Bayley	8	I	40	41
American	6½	B/C	39¾	45½
American	7	HV	44	50½
Buffalo	8	CL	48	48
New York	40	ME	49	53¾
American	9	AHS	53¾	61

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STEEL PLATE EXHAUSTERS

MAKE	TYPE	SIZE	Type Wheel	Wheel Diam.
American	E	35	Rim	23
Sturtevant	Des. 2	40	Rim	24
Bayley	SS	30	SS	25
Buffalo	SP	40	Rim	26
Sturtevant	Des. 2	35	SS	27
Garden City	SP	30	Cycloid	28
Cyclone B.P.	SS	40	SS	29
Sturtevant	Des. 2	45	SS	32
Sturtevant	Des. 1	55	Rim	33
American	E	55	Open	36
Clarage	IE	23	Open	36
Garden City	Cycloid	55	Cycloid	39
Sturtevant	SS	50	SS	40
Sturtevant	SS	55	SS	44
Buffalo	SS	50	Wool	45
Alington-Cur.	SS	60	SS	48
Buffalo	SS	70	Cotton	48
Alington-Cur.	SS	70	SS	56
Sturtevant	ME	70	SS	56
Alington-Cur.	SS	80	SS	64

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1—Buflovak Vacuum Double Drum Dryer, 24" x 48".
1—Stokes Rotary Vacuum Dryer, 3'x12'.
1—Vulcan Rotary Kiln, 7'x120'.
7—Devine Vacuum Shelf Dryers, 5 & 9 Shelves.
1—Buflovak Vacuum Shelf Dryers, 20 Shelves Each.
1—Buflovak Double Drum Dryer, 32"x90".
1—Louisville Steam Tube Dryer, 6'x50'.
2—Buflovak Vacuum Drum Dryers, 24"x20".
1—Devine Rotary Vacuum Dryer, 5'x25'.
2—Buflovak Double Door Vacuum Shelf Dryers, 20 shelves each.

FILTERS

1—Sweetland #2 Stainless Steel Filter, 12-16" Leaves, 28 Sq. Ft.
2—Sperry Cast Iron 24" x 24" Filter Presses, Closed Delivery, 30 Chambers.
2—Oliver Rotary Vacum Filters, 5'9"x8', Steel Construction with Monel Screens.
1—Oliver Homogenous Lead Filter, 8'x8'.
1—Sperry Aluminum Plate & Frame Filter Press, 42"x42", Closed Delivery, 3" Frames, 35 Chambers.
1—Bird 24" Monel Screen Type Centrifugal Filter.
1—Shriver Stainless Steel Filter Press, 24"x 24", Closed Delivery, 10 Chambers.
3—Shriver 24"x24" Aluminum Plate & Frame, Filter Presses, Closed Delivery, 35 Chambers each.
1—Sperry 42" C I Plate & Frame Filter Press, 18 Chambers, Closed Delivery.
5—Sweetland Filters, #2, 5, 7 and 12.
1—Oliver Rotary Steel Filter 3'x1'.

CENTRIFUGALS

1—Fletcher Stainless Steel Suspended Type Centrifuge, 40" Perforated Basket.
2—A. T. & M. S S Susp. Centrifuges, 48" Imperforated Baskets.
1—Fletcher 48" Centrifuge, Bronze Perforated Basket, Motor.
6—Sharples #16-Y Stainless Steel Super Clarifying Centrifuges.

MIXERS

1—Baker Perkins Stainless Steel Jacketed Double Arm Mixer, Sigma Blades, 9 Gals.
1—Baker Perkins Stainless Steel Dispersion Mixer, Size 15, Type VUMM, 100 Gals.
8—1-HP Explosion Proof Gear Head Mixers with Stainless Steel Type 316 Propellers & Shaft, 445 RPM.
1—Struthers Wells Double Arm "Northmaster" Mixer, 50 Gals. Working Cap., 100 Gals. Total Cap.
5—Simpson #0 Intensive Mixers.
3—Day #30 Imperial Jacketed Double Arm, Sigma Blade Mixers, 75 Gal. Working Cap.
2—J. H. Day Jacketed Powder Mixers, 800 lbs. each, with 5 HP Gear Head Motors.
1—Simpson #1 Intensive Mixer.
4—Baker Perkins Steel Jacketed Mixers, Sigma Blades, 100 Gals.
3—Baker Perkins Stainless Steel, Jacketed Mixers, Sigma Blades, 100 Gals.
3—Turbo Steel Jack. Mixers, 700 Gals. Each.

PULVERIZERS—GRINDERS—MILLS

1—Abbe #00 Rotary Cutter with 3 HP Motor.
1—Mikro #2TH Stainless Steel Pulverizer.
1—Mikro #3TH Mikro Pulverizer with 30 HP Motor.
1—Mikro #3W Pulverizer.
1—Mikro #2TH Pulverizer, Stainless Steel & Bronze Construction, with Motor.
1—Abbe #2 Master Rotary Cutter.
1—Ball & Jewell #0 S.S. Rotary Cutter.
2—Ball & Jewell #2 Rotary Cutters.
1—Blaw Knox Air Mill Pulverizer.
1—Mikro Stainless Steel Atomizer #8.
3—Thropp 2-Roll Rubber Mills, 18"x50".
1—Abbe #2 Buhrstone lined Pebble Mill, 5'x4'.
1—Gruendler #24-40 Hammer Mill.
1—Thropp 2-Roll Rubber Mill, 10"x24".
1—Sprout Waldron #36 Attrition Mill with 2-75 HP Motors.
1—Raymond 10" Lab. Air Separator with ½ HP Motor.

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1—Plaudler 500 Gals. Jacketed Vacuum Reactor.
1—Combustion Engineering Stainless Steel Jacketed Autoclave, 500 Gals., 300 PSI.
1—Plaudler 100 Gals. Glass Lined Jacketed Vacuum Distillation Unit with Stainless Steel 60 Sq. Ft. Conditioner and Stainless Steel Receiver.
1—Plaudler Glass lined Jacketed Vacuum Reactor 75 gal. with Anchor Type Agitator & Drive.
4—Plaudler Glass lined Jacketed Vacuum Reactors, 200 gal. each, with Anchor Type Agitators & Drives.
1—Plaudler Glass lined Jacketed Reactor with Anchor Type Agitator & Drive. Unused. 500 gal.
3—250 gal. Stainless Steel Vacuum Reactors.
1—450 gal. Stainless Steel Jacketed Kettle.
12—Koven Stainless Steel Jacketed Vacuum Kettles, 300 Gals. Cap. Ea.
1—Struthers Wells Steel Jacketed Vacuum Reactor, 1800 Gals. Cap. with Drive, Turbine Agitator & Coils.

1—Readco type 316 Stainless Steel Jacketed Powder Mixer, 1000# Cap., 125# Jack., ASME Constructed.
1—Swanson-Walker type 316 S.S. Jacketed Crystallizer. 4—10' Sections.
1—Type 316 Stainless Steel Horizontal Storage Tank 1500 gal., dished head.
1—Type 347 Stainless Steel Tank with Coils. 3000 gals., dished head.
1—Buflovak type 347 Stainless Steel Rotary Vacuum Dryer, 5' x 20'.
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1—Patterson Steel Jacketed Autoclave, 900 Gals. Cap., Internal Pressure 120 Lbs.
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9—Alco Heat Exchangers, 360 Sq. Ft.

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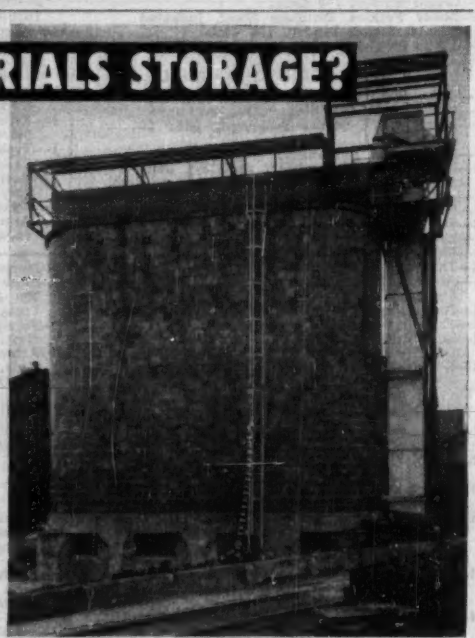

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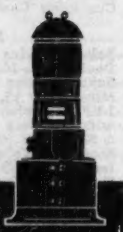

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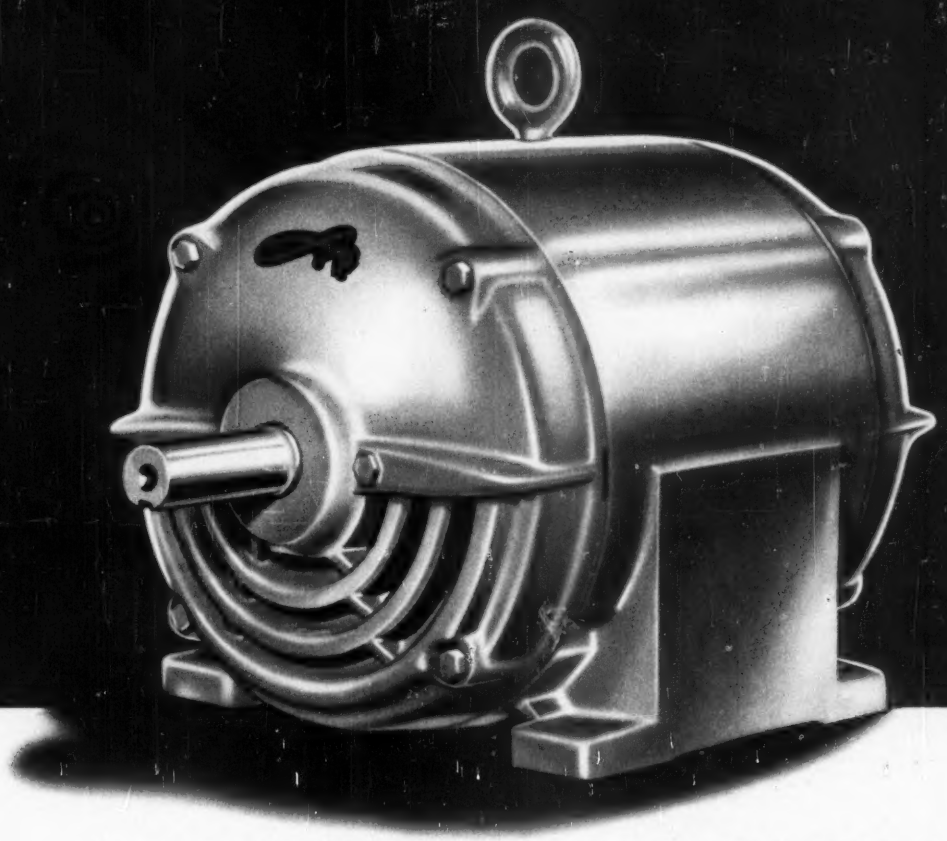

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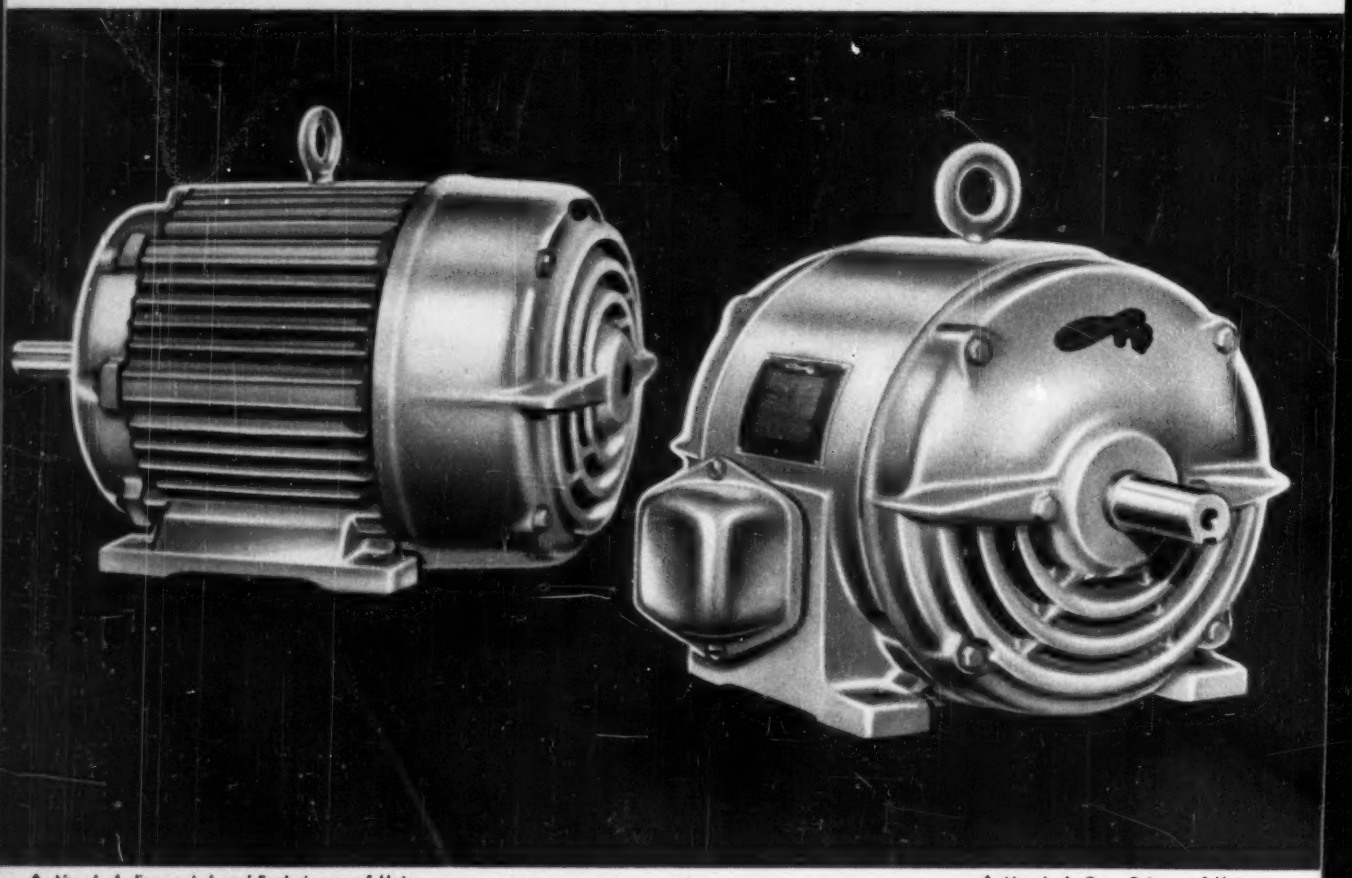

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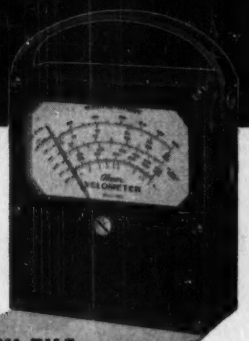

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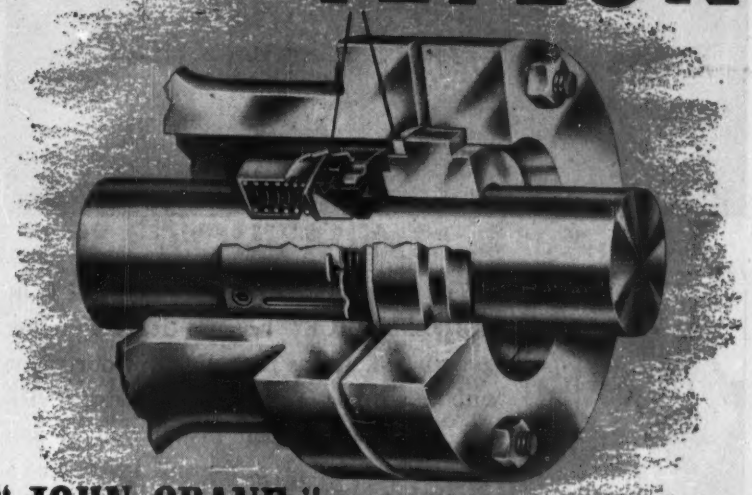

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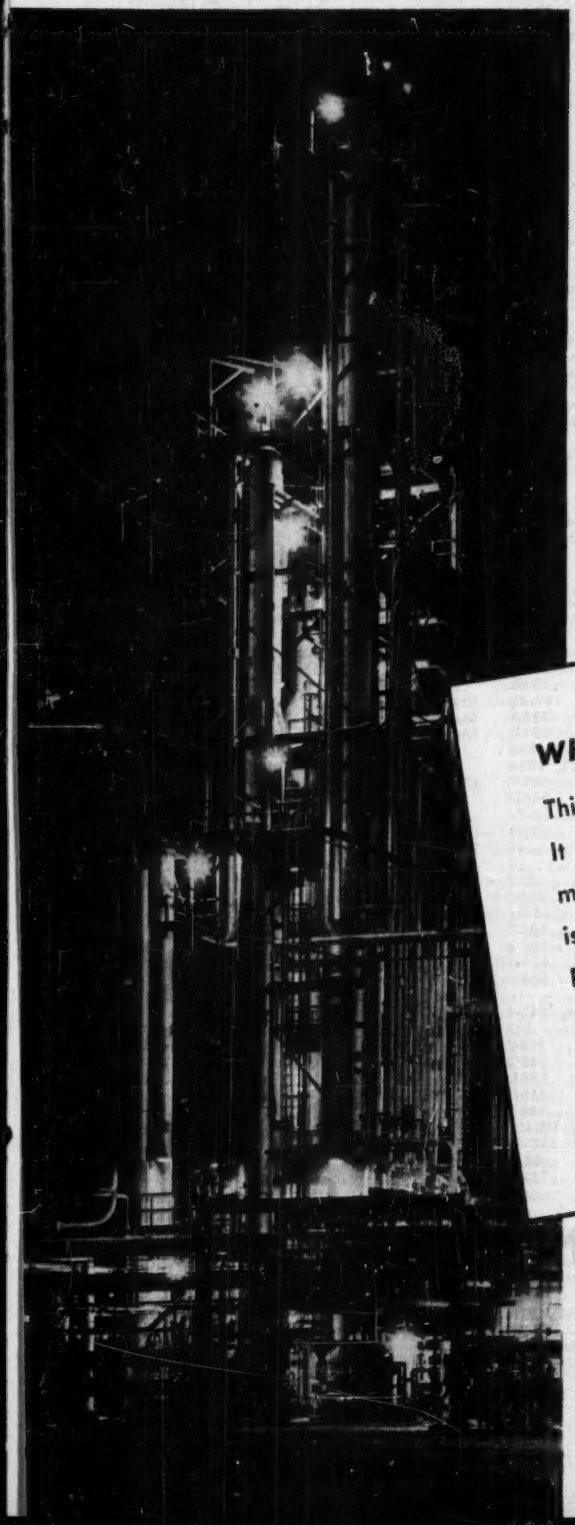

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Absorbers 58-9c — Absorption of hydrogen chloride & other gases. Produces up to 20 tons per day 22° Baumé acid. Compact, lightweight, pneumatic automatic control, etc. Catalog S-7460. National Carbon.

Accelerometers 487A — Feature subminiature size & weight, excellent stability, wide frequency range, high acceleration range. Includes characteristics, photos, diagrams. Bulletin A314. Gulton Mfg. Corp.

Benzene Alkyl 487B — Procedures for getting a variety of surface active end products from sulfonation of alkyl benzene. Analytical procedures for general property tests. Bulletin P-148. Monsanto Chemical Co.

Alloys, Nickel 487C — 32 p. with new illustrations and data, on the use of alloys to meet the requirements of improved design and modern methods of manufacture of railroad equipment. International Nickel Co.

Analyzers 487D — Describes complex plane analyzer, a computer for network analysis & control system design. Includes theory, operation, specifications. Cites principal features. Diagrammed. Technology Instrument.

Analyzers, Polarographic 487E — Semi-automatic laboratory instrumentation for petroleum analysis. Direct-reading push button polarographic analyzer for tetraethyllead in gasoline. Bulletin FS-235. Fisher Scientific.

Annunciator Systems 347 — Standard chassis is interchangeable without rewiring for all types of annunciator service; standard audio-visual; ringback; bullseyes or nameplate, etc. Cat. 100-A. Panalarm Products.

Anodes, Plating 487F — Describes copper, lead, zinc, tin, tin-lead, cadmium, cadmium oxide & brass plating anodes. Data on sizes, shapes, compositions & other characteristics. Bulletin 141. American Smelting & Refining Co.

Automation 29 — Increasing complexity of petrochemical processing calls for automation beyond today's approach to measurement & control. Discusses future of instrumentation. Minneapolis-Honeywell.

Bag Closing Machines T300 — Covers product line with illustrations & data charts. Built to meet heavy production schedules at lower cost. Strong closures for dependability. Bulletin 200. Union Special Mach.

Bag Manufacture 487G — Equipment for increasing efficiency & lowering unit costs in seaming & hemming operations. Constructions used in making cloth, paper & mesh bags. Illustrated Bulletin 262. Union Special Machine Co.

Balances 487H — 39 p. covers scales, balances, weights, accessories. Includes trip scales, analytical, torsion, spring, specific gravity, special purpose & general laboratory balances. Bulletin 15C. Central Scientific.

Balls, Steel 487I — Literature on chrome steel balls, stainless steel balls, etc. Applications for bearings in armatures, valves & pumps, as casters, burnishing balls, gage, crushing & grinding balls. Frazar & Co.

Barrel Finishing, Precision 487J — Compounds for descaling, deburring, abrasive & non-abrasive cut-down, finishing, coloring, etc. Industrial purposes, characteristics, uses, advantages, field data. 32 p. Lord Chemical Corp.

Batteries, Storage 487K — 24 p. describes automotive storage batteries. Data on how a battery operates and how to keep it performing at maximum efficiency throughout its life. Electric Storage Battery Co.

Bearings, Ball 487L — 20 p. of design & application data, with drawings, graphs, tables, photos, on miniature ball bearings. Data on radial, angular contact, pivot & thrust bearings. Miniature Precision Bearings, Inc.

Bearings, Motor 70a — Facts on advantages of pre-lubricated bearing design, with cutaway view, cross-section diagram, comparison chart, and statements by bearing manufacturers. Bulletin B-2201. Reliance Electric.

Belts, V- 394 — Adjustable v-belt provides vibrationless, full power delivery. Easier to stock & control because it is packaged on 100-ft. reels in every standard widths. 28 p. Manheim Mfg. & Belting Co.

Benthal 487M — Used in production of short & medium oil alkyd resins to control viscosity. Acts as molecular chain stopper. Improves resin durability, alkali & water resistance & film gloss. Monsanto Chem.

Beryllium Copper Tools 487N — Non-sparking property safeguards against accidental fire or explosion caused by sparks. Beryllium copper tools are also non-corrosive. 31 types of safety tools described. Beryllium Corp.

Blenders 438 — More thorough blending in less time of hard-to-blend finely divided powders. Replaces former methods which required separate drum for every mix. Catalog 12. Patterson-Kelley.

Blowers & Compressors 487O — Specializes in the design & manufacture of blowers, compressors & air & gas handling equipment, both axial & centrifugal flow. Reviews manufacturing facilities & products. Sawyer Bailey.

Bricks, Floor 487P — Modernization of industrial flooring. Describes contracting services, floor bricks & shapes, joint filler, drains & floor plates. Varied applications. Bulletin M3. Drehmann Paving & Flooring Co.

Buckets, Elevator 487Q — For handling coal, coke, ores, grain, cement, pulp, chemicals, etc. Well-rounded corners promote easy discharge. 55 sizes listed. Dimensions, weights, capacities. Book 2465. Link-Belt Co.

Burners 487R — Gives hole sizes, flame patterns, gas consumption on various gases & complete information with illustrations of burners, blow pipes, glass fires, mixers, inserts, etc. American Gas Furnace Co.

Burners, Oil 487S — Fully automatic burners with construction features & hourly capacity ratings. Burns heaviest oils for economy & value. Available in various types & all sizes. Brochure A-604. Ray Oil Burner.

Cables, Aerial 87T — Physical & electrical characteristics of self-supporting aerial cables with aluminum conductors. Complete dimensional data & current carrying capacity tables. Bulletin OK-1064, Okonite Co.

Calcium Cabonates, Precipitated 487U — Valuable as premium extender & additive in paint manufacture. In printing inks, it is less abrasive than similar materials. General properties. Technical Service Report P-18. Witco Chemical.

Calculators, Alloy & Steel Weight 487V — Provides weights of strips, sheets, bars & plates of various metals & alloys. Factors are given for steel, stainless steel, nickel, monel, inconel, aluminum, etc. Continental Copper & Steel Ind.

Calculators, Fan Scale 487W — Utilizes new principle in spectrochemical calulating equipment. Provides continuous check on gamma & eliminates need for plotting emulsion characteristic curve. 4 p. Bulletin. Jarrell-Ash Co.

Calculators, Heat Exchanger 487X — Shows heat transfer coefficients for the shell side & tube side, which combined with proper fouling factors, determines over-all heat transfer coefficients. Young Radiator Co.

Calculators, Vacuum 487Y — For rapid slide-rule calculations. Includes a standard ABCD log scale. Helps to determine the proper pump to be installed for specific process. F. J. Stokes Machine Co.

Calenders 487Z — Used for calendering both rubber & plastic products. Can be furnished with embossing unit integral with, or separate from, the calender, & with cooling train & windup. Farrel-Birmingham.

Carbon 487AA — Features high purity. An ideal carbon raiser, heat producer, reducing agent. It is highly reactive, & has high resistivity. Low priced & available in large quantities. 14 p. Portland Gas & Coke Co.

Carbon Dosage 287 — Darcograph solves carbon dosage problems. A graphical calculating device that saves much time in determining minimum dosages. Mathematically correct, simple to use, easy to understand. Darco Dept.

Casters & Wheels L457 — Provide maximum floor protection, economy & efficiency. Sturdy construction gives extra long life of satisfactory service. Types and sizes for every purpose. Darnell Corp.

Caustic Soda 25 — Effectively standardize processing methods. Inspections & analyses safeguard uniformity of caustic. Data sheets offered. Bulletin 100 describes products & services. Hooker.

Cells, Pressure 487BB — Utilization & specifications of new high frequency pressure cells in the measurement of rapidly changing pressures up to 20,000 lbs. per sq. in. Bulletin 4107. Baldwin-Lima-Hamilton Corp.

Centrifugals 132 — Automatic electric drive centrifugals designed for efficient, economical operation. 48" x 30" basket—1200 R.P.M. Cites features & describes other basic models. Western States Mach.

Centrifugals 146 — Combine filtering & dehydrating with no loss in time. Also involves extraction, coating, clarification, draining, thickening, impregnation, etc. Illustrated. American Tool & Mach.

Centrifugals, Continuous 375 — Feature quick, 3-way adjustability. Hydraulic-mechanical combination drive with hand wheel control allows rapid selection of basch speed from 0 to 300 inches per minute. Tolhurst.

Centrifuges 21 — Detailed information about centrifuges includes prices, production, square feet of filtering surface, construction, weight, maintenance, etc. Booklet 4-RC-3. Heyl & Patterson.

Technical Literature Now Available, *cont* . . .

Chlorine Bulletins 341	#7—"Liquid Chlorine"; #8—"Alkalies & Chlorine in Treatment of Municipal & Industrial Water"; #11—"Water Analysis"; #14—"Chlorine Bleach Solutions"; etc. Solvay Process.
Clarifiers L410	Solve water treatment problems in less space at lower cost. Can provide water supply in fraction of space needed by other types of equipment. Bulletin 1825-K. Infilco.
Classification Units 218A	Cylindro-conical units utilizes centrifugal force in place of gravity. For fine classification problems in 2-20 micron range. Description, application, diagrams, operating data, etc. Bulletin 2502. Dorr.
Cleaners 488A	Describes new heavy duty cleaner for wet or dry-pickup. Specifications and illustrations of the tank and various tool kits for specialized cleaning jobs included in literature. Premier Co.
Cleaners, Tube 244	Fast & economical tube cleaner for refinery & process heat exchangers. Immediately removes deposits from completely plugged heat exchanger tubes. Bulletin TW-1046. Thomas C. Wilson.
Coal Tar Chemicals 488B	Contains 60 compounds, indexed alphabetically & by class. Provides chemical name, grade and availability. New compounds now available in commercial amounts. Reilly Tar & Chem. Corp.
Coatings, Protective 486C	Details about new product described as paint, plaster, color & texture combined in one protective coating. Advantages, application data & color charts in two bulletins. Enterprise Paint Mfg.
Coatings, Protective 107	For thermal insulation or corrosion prevention. Feature flexibility, tough fillers which absorb physical abuse, mica which reflects harmful rays of sun, etc. Insul-Mastic Corp.
Coatings, Protective 488D	Sprayable, heavy-bodied liquid vinyl plastic. Used for waterproofing & for protection against rust & corrosion. Describes tensile strength, elasticity, adhesion, cohesion, etc. Protective Coatings.
Coatings, Protective 139	Neoprene based, & provide surface that is inert & impervious to broad range of corrosives in fume or splash form. Resist acids, alkalies, oils, greases, salts, etc. Bulletin 7-55E. Atlas Mineral Products.
Coil Holders 488E	Describes how coil holders improve wire stitching operation. Gives advantages of 25 lb. & 50 lb. models. Photographs & diagrams included. Installation & maintenance. Acme Steel Co.
Coils & Bends 302a	Coils & fabricated bends of all types. Fabrication processes & techniques available for various needs—whether it involves big pipe or small tubing. Bulletin 94. Whitlock Mfg.
Coils, Steam 92	For normal blast heating. Tested & guaranteed for operation with steam up to 200 lbs. gage pressure & 450° F temperature. Die-formed tube support protects tubes. Bulletin B-1218. American Blower.
Collectors T231a	Provide efficient removal of air-borne contamination (dust, fumes, vapors, acid gases & odors) and recovery of product through multiple washing action. Bulletin 610. Claude B. Schneible Co.
Colors, Coating 488F	Discusses preparation of coating color with emphasis on casein formulations. Helpful in the control of conditions which promote production uniformity. Bulletin 832. Calco Chemical Div.
Combustion Control 488G	Automatic combustion control systems in metering or positioning types. Maintains desired steam pressure & provides fuel & operating economy. Describes product line. 4 p. Standard Instrument.
Combustion Processes 488H	How too much or too little air can be costly in combustion processes. Use of oxygen can mean greater overall process efficiency & more profits. Illustrated Bulletin AD-607. Arnold O. Beckman.

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Compressors, Centrifugal 488I	For fluidized feeding. Feature greatly increased capacities & attainment of high pressures with small physical dimensions, light weight & high efficiency. Application Report 101. Sawyer Bailey.
Compressors, Steam-Powered 457	Designed to compress air or gas with greatest over-all efficiency. Feature full-floating bearings. Wear on non-adjustable bearings is slight. Bulletin 3444-A. Ingersoll-Rand.
Compressors, Vertical 285	Water-cooled, double-acting, single-stage compressor built to deliver medium amounts of air constantly. Offers replaceable crosshead guides and cylinder liners. Bulletin A-43. Joy Mfg. Co.
Construction 488J	Emphasizes role of construction in industrial advancement & expansion. Wide assortment of applications. Also operations in marine salvage & derrick heavy hoisting. 28 p. Merritt-Chapman & Scott.
Control Centers, Motor 44	Accessible units interchangeable, light in weight, easily serviced in "disconnect position," operate safely even when serviced. Bulletin GEA-4979A. General Electric Co.
Control Systems 488K	Describes photoelectric side register control systems. Designed for use on slitting, rewinding, side trimming & printing operations. Uses & features of two types. Bulletin GEA-5947. General Electric.
Controllers, Electronic 240B	Indicating or recording controllers for temperature, pressure, flow, liquid level, humidity & time program control. Adaptable to wide range of control problems. Specifications. Bulletin B226. Bristol.
Controllers, Pneumatic 241B	Incorporates 3 modes of control response. Has added rate action to previously available adjustable proportional band response & automatic reset action. Literature SS 771. Minneapolis-Honeywell Regulator.
Controls 52	Safeguards for personnel & high-voltage equipment. Protects equipment from the explosive & shattering effects of sudden electrical overloads. Bulletin GEA-5409. General Electric.
Controls, Boiler Water 488L	Describes product line of boiler water level controls & safety devices. Includes data on safety-water feeders, low water fuel cut-offs, pressure relief valves, etc. McDonnell & Miller.
Controls, Electronic 488M	New factual data & explanatory diagrams show how electronic controls can solve industrial problems. Efficiency achieved thru counting, weighing, timing, measuring & cycling. Photoswitch, Inc.
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Controls, Liquid Level 53	Accurate control of liquid level. Eliminate problems caused by troublesome linkages, torque tubes, floats & stuffing boxes. Unaffected by surface agitation. Descriptive Data PC-37. Leslie Co.
Controls, Programming 242A	For commercial-industrial gas, oil, or combination gas/oil burners. Complete specifications, wiring diagrams & programming sequences included. Installation Bulletin CP522. Combustion Control Corp.
Conveying Systems 22	Convey dry, pulverized & granular materials such as lime, soda ash, clays, borax, cellulose acetate, etc. & keep handling costs down. Dustless operation. Bulletin G-1. Fuller Co.
Conveyors, Belt 488N	60 p. shows entire range of belt conveyors. Accessory line described. Typical conveyor layouts, applications, installation photos, line drawings, etc. Illustrated Catalog 76A. Barber-Greene.
Conveyors, Screw 13	92 p. features uniformity of pitch, specially selected steels, wide range of hanger styles, gates easily installed on the job, accurately fabricated troughs, etc. Data Book 2289. Link-Belt Co.
Coolers, Cascade 58-9b	For cooling corrosive liquids & gases. Low initial cost & maintenance, radiused returns for low pressure drop, redwood waterguide strips. Catalog S-6820. National Carbon.
Copolymers, Styrene 488O	Formulas developed to obtain high quality, low cost GR-S rubber compounds with high styrene resins. Includes gravities & physical properties. Bulletin C-11, 12, 13. Dewey & Almy Chem. Co.
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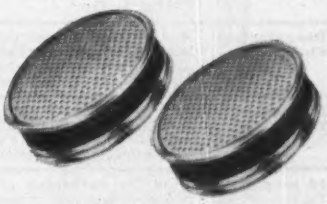

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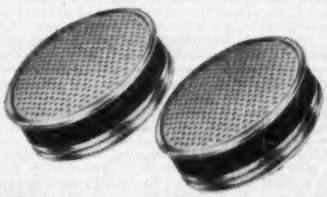

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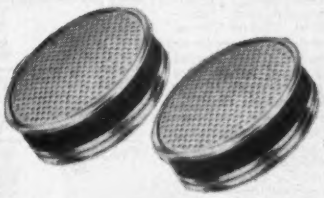

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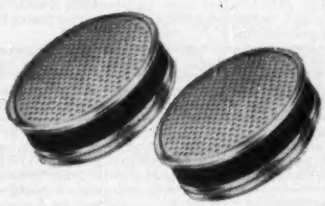

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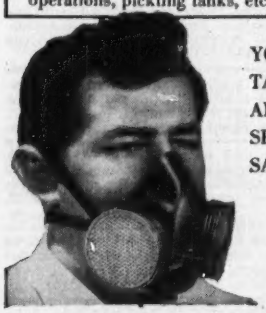

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Crushers 220A — For impact reduction of chemical solids & metallurgical materials to cubical particles. Impact crushing & closed circuit screening. Construction & specifications. Bulletin 8003. Pennsylvania Crusher.

Crushers, Roll 489C — Gives pressure needed for low-cost, high-ratio secondary crushing. Field-proven for long life, low maintenance, minimum requirements. Capacities, sizes, etc. Bulletin 1120. Lippmann Engrg.

Demisters 374 — Simple means to improve performance & increase capacities of process equipment handling vapor & liquid materials. Advantages & engineering data in Catalog 13. Otto H. York Co.

Design & Construction 489D — Offers design & construction services to public & private business. Summarizes projects & shows technical range & diversity of engineers. 32 p. Photos, sketches, diagrams. Kaiser Engineers.

Detergents 489E — Cleans petroleum processing equipment. Describes concentrations, temperatures, tank & circulation methods of application to remove soils with varying characteristics. Oakite Products, Inc.

Dialkyl Alkiphosphonates 489F — New series of stable organic phosphorus compounds now available for first time in commercial amounts. Indicated applications, properties, uses & selected bibliographies. Virginia-Carolina Chemical Corp.

Diammonium Phosphate 489G — New method for automatic control of wool dyeing. Victor process offers relief from costly fluctuations in starting alkalinity, penetration, levelness, etc. Technical Bulletin V2-52. Victor Chem.

Dispensers, Tape 489H — Affords savings in shipping room time & material costs. Handles filament inserted tapes as well as cloth & paper types. Describes advantages of the dial selection. Gummed Tape & Devices Co.

Dispersions, Carbon Black 489I — Used for darkening of air-entrained or regular concrete in either monolithic or topping construction. Reduces road glare & driving hazards. Test data, uses, recommendations. A. C. Horn Co.

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Dockboards, Magnesium 489K — Used to bridge the gap between loading docks & rail cars & highway trailers. Discusses safety & operating features, installation, durability, delivery, etc. Magnesium Company of America.

Drives 390 — Sturdy construction, improved design, compact housings offer superior performance & maintenance savings. Ratios up to 4,108 to 1—capacities to 260 hp. Bulletin HGB. Foote Bros.

Drives, Fluid 90 — Constant cushion action provides shock & overload protection & eliminates high starting torque requirements & high starting currents. Covers 5 types of fluid drives. Book 2485. Link-Belt Co.

Drives, Speed 167e — Company offers literature which describes a complete line of adjustable speed drives for coordinating all kinds of production processes. Bulletin No. 11-1-P1. Century Electric Co.

Drives, V-Belt 489L — 52 p. technical manual covers all elements of v-belt drives. Includes subjects dealing with selection & information on various drives. Tables, graphs & diagrams. Boston Woven Hose & Rubber.

Drum Handling Attachments 489M — Engage, transport, place & tier drums without use of pallets or dunnage. Automatic, mechanical unit, it handles any conventional size drum. Quickly detachable. Illustrated. Lewis-Shepard.

Dryers B128 — Literature gives full information on the Turbo-Dryer. Gentle handling through repeated piling and spreading for granules, powders, crystals, sludges, etc. Wyssmont Co.

Dryers, Rotary B235a — Illustrated catalog offered which includes dewatering presses and screens, rotary steam tube, hot air and direct fire dryers, water tube and air coolers. Davenport Machine & Foundry Co.

Dust Collectors 489N — Cabinet & cyclone types. Illustrates adaptability to meet specific dust collecting problems. Selection data, sketches, specification charts giving over-all dimensions. 16 p. Torit Mfg. Co.

Dust Collectors 266 — Describes dust control & its advantages. Large reclamation savings result from effective trapping of valuable chemical dusts. Maintenance costs lowered. Bulletin 909A. Pangborn Corp.

Dust Recovery 297a — New profits in terms of tons of valuable dust that can be returned to production rather than wasted in the air. Brochure explains 8 systems of industrial dust recovery. Buell Engrg. Co.

Elbows, Welding 415 — Covers 4 different types. Large selection gives engineer greater latitude in piping design & permits improvements & economies not otherwise possible. Catalog 48. Midwest Piping.

Electric Furnace Products 56-1a — Basic materials for solving processing problems. Aluminum oxide, silicon carbide, boron carbide, fused stabilized zirconia, boron nitride, etc. Actual & suggested uses. 22 p. Norton Co.

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Engines, Diesel 489R — More power through improved scavenging, increased speed, better combustion & more savings through lower fuel costs, lower maintenance, longer life. Illustrated Bulletin 224A. Nordberg Mfg. Co.

Essential Oils 489S — Includes prices on essential oils, aromatic chemicals, animal fixatives, oleoresins, colors, gums, balsams, etc. Distribution limited to those who buy in wholesale quantities. Fritzsche Bros.

Ethyl Acetate 489T — Technical data sheet includes general description, CSC specifications, physical properties, uses, toxicity, shipping, handling & storage & shipping containers. TDS 20. Commercial Solvents Corp.

Ethyl Acetoacetate 489U — Physical & chemical properties, specifications, shipping data, uses, potential applications. Intermediate used in pharmaceutical & dvestuff industries. Bulletin F-8292. Carbide & Carbon.

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Fabrication, Metal 489V — Illustrated 48 p. book portrays company's extensive metal fabricating and production facilities, products and services, capacity to serve industry. Over-all operation. R. C. Mahon Co.

Fans, Propeller 16 — Available in many sizes, to 90,000 cfm. Can handle ventilating & exhausting jobs at lower flat cost & lower cost installation. Bulletin 3865. Heavy-duty type. Bulletin F3790. Buffalo Forge.

Fasteners, Stainless Steel 489W — 96 p. describes bolts, nuts, screws, washers, keys, pins, studs, rivets, nails, valves & fittings, etc. Includes engineering information & approximate weights. Catalog 53. Allmetal Screw Products Co.

Fertilizer Manufacture Ammoniated 489X — Obtaining desired results in manufacture & conditioning of ammoniated mixed-goods. Techniques proven to be efficient & economical in plant application. Bulletin 53. Universal Detergents.

Fertilizers 354A — Describes the manufacture, economic advantages to the farmer, chemical and physical properties, packaging, storage, acidity, etc. Special features cited. Bulletin PD-A12. Nitrogen Div.

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Filters, Ventilation 489Y — Specifications, engineering & performance data covering dry type panel filters recommended for removal of air-borne impurities. Graphs, photos, tables, drawings. Bulletin 600. Dollinger Corp.

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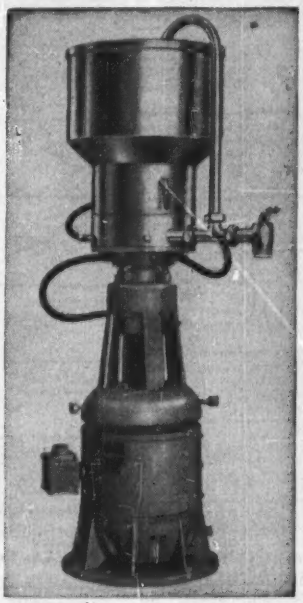

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Fittings, Tube 54-5
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Fittings, Welding 492C
Data on large welding fittings. Covers elbows, caps & tees with standard & extra strong wall thickness. Provides complete specifications. Photos & diagrams. 4 p. Tube Turns, Inc.

Fittings, Welding 22
Precision-process manufacture begins with the billet, continues thru the making of the seamless steel tube, & extends thru to production of the finished fittings. Globe Steel.

Food Technology 492D
Brochure describes facilities & services available to industry for research in all phases of food technology field. Outlines potential of research in field. Illinois Institute of Technology.

Formalin Handling 301
Manual covers unloading, storing, temperature effects, safety precautions, tankcar construction, methods of analysis, first aid, properties, specifications, etc. Celanese Corp.

Frames, Steel 492E
Installation photos, illustrations, data on various types & sizes of channel frame & fittings, engineering data charts. Used for racks, supports, hangers, etc. Catalog 100. Ainsworth Mfg.

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Generators 167e
Two bulletins available for AC and DC generators. AC generators—.63 to 250 KVA refers to Bulletin No. 18-1P21. DC generators—.75 to 200 KW refers to Bulletin No. 18-1P1. Century Electric Co.

Generators, Inert Gas 86
Fast-starting, easy-to-operate, insure adequate inert gas production. Generators help meet purging or blanketing problems. Complete with fire checks & safety devices. Bulletin 1-10. C. M. Kemp Mfg. Co.

Generators, Steam R300
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Generators, Steam 492J
20 p. describes 8 basic arrangements of two, three & four drum steam generators. Also heat recovery units & process equipment. Design drawings & photos. Bulletin G.B.-153. Union Iron Works.

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Glassed Steel Equipment 492L
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Heat Exchangers 492N
Describes standard heat exchangers of several different designs as commonly built for process industries. Includes details of design & construction. 8 p. Bulletin 250. Whitlock Mfg. Co.

Heat Exchangers 58-9a
Feature chemical resistance to practically all corrosive fluids, resistance to severe thermal shock, high heat-transfer rates, low maintenance, etc. Catalog S-6740. National Carbon.

Heat Exchangers 492O
Maximum heat transfer at minimum cost. For automotive, agricultural, industrial, gas & diesel engine applications. Details on design features. Catalogs 1049, 1149. Young Radiator Co.

Heaters, Unit 492P
Shows wide scope of commercial, institutional & industrial heating installations. Includes unusual spot-heating applications. 12 p. Illustrated. Bulletin 14. Industrial Unit Heater Association.

Heating, Electrical 492Q
Proper & efficient application of electrical heating elements & devices. Specifications for wide variety of applications. Handy application guide. Illustrated, 29 p. Catalog 53. Heatube Corp.

High Temperature Equipment 492R
Describes high temperature process equipment. Technical publications covering Hughes coke oven offer results of coking study & a demonstration of the oven's versatility. Petrocarb Equipment.

Hoists, Electric 492S
Compact, planetary gear, wire rope type hoist. Capacities from 250 to 2000 lbs. Parallel or cross mounted with bolt, hook or trolley suspension. Illustrated Bulletin 182. Shepard Niles.

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Hose, Flexible Metal 405
Solves flexible connection problems. Corrugated & convoluted types in wide variety of designs & complete range of sizes. In various metals. Specifications. Catalog 130. Flexonics.

Hose, Flexible Metal 18
Varied applications for flexible metal hose & tubing. Shows how tubing is designed, used & installed. Includes specifications on tubing & fittings. Booklet CC-400. American Brass.

Hose Selectors 492T
Starting with any known factor (I.D., O.D., minimum burst, bend radius, etc.) selector can determine proper rubber covered hydraulic control hose for specific operation. Republic Rubber Div.

Humidity Conditioning 346
Solves atmospheric moisture problems. Supplies direct dehumidification. Prevents frost, condensation, corrosion. Used for packaging, storage, etc. of many products. Surface Combustion Corp.

Industrial Chemicals 492U
104 p. describes properties, specifications, uses, shipping data, packaging for many heavy chemicals. Tables & graphs. Shows company's history, growth, product line. Consolidated Chem.

Industrial Vision 489a
Company's industrial vision program makes for increased production and decreases the number of accidents. Offers booklet entitled "Improved Industrial Vision." American Optical.

Instruments & Controls 274-5a
Better temperature instrumentation. Instruments provide desired accuracy & automatic controls regulate any production process. Product line. Catalog 5000. Minneapolis-Honeywell.

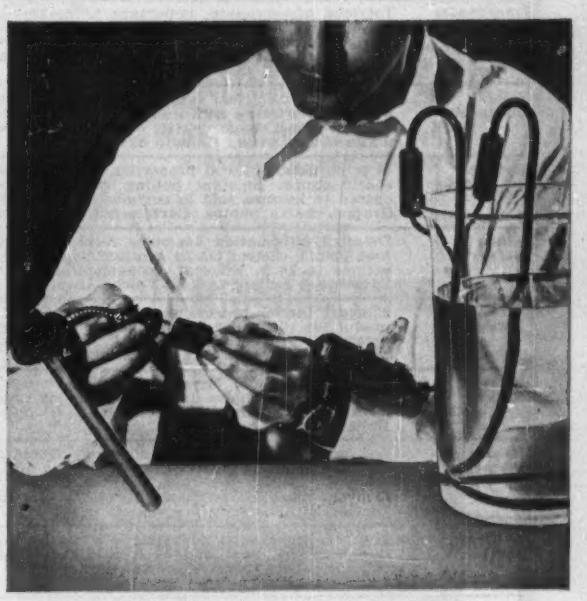
Instruments, Precision 492V
Instant, accurate readings of air velocities anywhere. Measure speed of air flow thru ducts, grilles, furnaces, spray booths, etc. Details & prices. Bulletin 2448-G. Illinois Testing.

Insulation 86-1
Descriptive literature on insulation that fuses itself into lifetime protection for hot underground pipes. Water, corrosion, root, acid and alkali-proof. Economical & easy-to-use. American Gilsonite Co.

Insulations 492W
8 p. on insulations, refractories, transite pipe, packings & gaskets, metal raschig rings. Offers data on properties & includes photographs which show typical installations. Johns-Manville.

How would YOU solve these two problems?

1. FLINTKOTE INSULATED SIDING is saturated with hot asphalt by a continuous conveyor process through a dip tank. Fenwal THERMOSWITCH® Thermostats, connected to pilot lights, warn when asphalt varies from safe operating level. The totally enclosed mechanism of the THERMOSWITCH units is not affected by the high heat (420°F) or viscosity of the liquid.



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3. YOU, TOO, MAY BENEFIT from a Fenwal THERMOSWITCH Control.* Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved many types of temperature control problems throughout industry. The external, single-metal shell expands or contracts *instantly* to temperature changes, making or breaking electrical contacts.

*Cartridge Type Illustrated

4. SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. Write Fenwal Incorporated, 169 Pleasant Street, Ashland, Massachusetts.

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Electric Temperature Control and Detection Devices

SENSITIVE . . . *but only to heat*

Technical Literature Now Available, *cont* . . .

Isocyanates 162-3d	Tolylene diisocyanate, important in foamed-in-place resins, finds new applications. General bulletin on products, No. P-125; foam resins, No. P-144; rubber adhesives, No. P-145. Monsanto Chemical Co.
Joints, Insulating 492X	Provide an electrical insulating barrier in pipe without interfering with its capacity or efficiency for conveying steam, water, chemicals or gases. Cross-section view. Bulletin 223. Barco Mfg.
Ketones 494A	44 p. on uses, physical properties, shipping data, specifications, constant boiling mixtures. Discusses 14 ketones sold in commercial quantities. Graphs, charts, photos. Carbide & Carbon Chem.
Kilns, Rotary 418	Detailed information describes rotary kilns for lime plants, cement plants & other modern applications in 28 p. Efficient, economical operation. Illustrated Bulletin A-442. Vulcan Iron.
Kilns, Rotary 17a	Efficient thermo-processing of products. Used in production of copper, lime, bauxite, paper products, etc. Features of rotary kilns, coolers & dryers. Bulletin 115. Traylor Engrg.
Kilns, Rotary B316b	Literature offered describing entire company product line. Includes data on continuous rotary kilns, dryers (single & double shell) & coolers. Bulletin 16-D-12. Hardinge.
Kyanite Flotation 494B	Recovery of kyanite by flotation. Flotation recovers about 90% of kyanite present in quarry rock. Describes operations that take place to recover final concentrate. Bulletin M4-B68. Denver Equip.
Laboratory Services 494C	20 p. on services for industrial chemicals, gasoline additives, textile dyes & food-grade antioxidants. Various tests & products analyzed. In 7 sections. Illustrated. Eastman Chemical.
Linings & Tile Tanks 494D	Design, installation & maintenance of corrosion-resistant linings & tile tanks to meet any chemical & physical conditions. Construction materials. Bulletin A-153. Stebbins Engrg. & Mfg. Co.
Low-Temperature Processes 379	Low temperature liquefaction & separation of gases. Recover valuable products from many gas mixtures. Built over 600 low-temperature gas separation plants. 36 p. Air Products.
Lubricants 142	Regardless of size and type of machinery, lubricants will improve its operation and reduce maintenance costs. Prevent wear and corrosion. 56 p. Data Book. Fiske Bros. Refining Co.
Lubrication, Open Gear 494E	Lubrication from viewpoint of research & laboratory control. Chemical & physical characteristics of more commonly used gear lubricants. Data on application, storing, handling, etc. Brooks Oil Co.
Magnets 409	Powerful, non-electric magnets stop iron in the hump, chutes or ducts. Magnetic strength guaranteed forever. Catalog C-1205-B. Product line in Catalog C-5000-B. Dings Magnetic.
Metals, Perforated 494F	36 p. describes round, square, oblong & ornamental perforations, ranging from .02" to 9.5" in diameter. Hole sizes, open areas, gage limits, varied applications, etc. Catalog 39. Diamond Mfg. Co.
Meters, Color Difference 494G	Measures color on 3 revolving scales. Records automatically the color difference due to ageing, heat & light exposure, etc. Operation, advantages, price data. Bulletin 144. Gardner Lab.
Meters, Flow 494H	Accurate measurement of fluid flows over wide ranges. For water, sewage, sludge, industrial liquors. Operation, construction, accuracy, primary devices, etc. 16 p. Bulletin 500. Simplex Valve & Meter.
Meters, Flow 494I	Measures air flow, gas flow & ratio of air flow to gas flow. Uses pilot method of operation; dry diaphragm-type measuring element; package unit constr. Publication 52-1017-37. Hays Corp.
Meters, Flow 60	Pneumatic electric metering for flow measurement problems. Keeps dangerous or high pressure fluids out of control rooms & mercury type meter bodies. Bulletin 704. Republic Flow.
Meters, Flow B300	Simple design with only 3 moving parts. Sound alarm at high or low flow on face of switch easily set. Flow indication within 3% accuracy including pulse flow. Henszey Co.
Meters, Positive Displacement 245	Features accuracy, compactness & capacity from 4,000 cfh to 1,000,000 cfh in one unit. Selection table helps choose right meter for specific application. Bulletin M-152. Roots-Connersville.
Methionine Hydroxy Analogue 494J	16 p. booklet describes this poultry feed supplement. Discusses its value in broiler feeds based on various tests. Contains history, application & efficiency of chemical. Monsanto Chemical Co.
Methylamines 339	Represent most economical source of amine group because of their low equivalent wts.& moderate cost. Many uses, specifications, properties, chemical reactions in TDS 12. Commercial Solvents Corp.
Mica, Glass-Bonded 494K	Designing parts to be machined from glass-bonded mica. Tables, specifications, charts, sketches. General considerations, sizes & shapes, inserts, tolerances, holes, etc. Mycalex Corp. of America.
Micrometers 494L	For laboratory & production use. Heavy duty construction & trouble-free operation. Can operate next to production equipment for years. In different dead weights & anvil sizes. Testing Mach.
Microscopes, Electron 494M	Features 50-kv accelerating potential, built-in camera, photographic magnification to 40,000X, 100 angstrom resolving power, etc. Operation & applications. Form 2J6851RE. Radio Corp. of America.
Mills, Laboratory 494N	Built in 4 designs. Different drive arrangements give wide choice of roll speeds & friction ratios. Standard & optional features. Mill design table. Illustrated. Farrel-Birmingham Co.
Mills, Roller 256	Grinds phosphate rock from all types of deposits. Also handles chemicals, non-metallic minerals & manufactured products. Economical for large tonnages. Catalog 69. Raymond Pulverizer Div.
Mixers 217a	Catalogs describing laboratory mixers, portable mixers, top entering mixers, etc. Data on impeller selection, sizing, best type of vessel, installation & operation hints. Mixing Equipment Co.
Mixers 494O	Electrically-driven mechanical mixers for homogenizing samples rapidly. Discusses operation & applications. Contains drawings, tables, charts. 7 p. Bulletin FS-238. Fisher Scientific Co.
Mixers 494P	Fill any need for dry & paste mixing. Covers mass & paste & spiral blade mixers, double cone blenders, vertical & ho[illegible]ontal mixing mills, ball & pebble mills. Illustr[illegible] Catalog V. Paul O. Abbe.
Mixers 494Q	Meet requirements for heavy duty kneading & mixing. Feature air seal type stuffing boxes, new dumping mechanism, heavy duty bearings, etc. Details & specifications. Bulletin 600. Day Co.
Mixing & Blending 158a	Data on chemical processing equipment. Includes heavy duty double-arm mixers, laboratory mixers, vertical mixers, spiral ribbon mixers, etc. Bulletin 53759. Read Standard.
Motor Units 380	Motor units for valves, gates and floorstands. Completely housed, dust-proof, weatherproof & designed for simplicity & extreme ruggedness. Catalog 50. Chapman Valve Mfg. Co.
Motors 355-6e	Condensed catalog describes all types of motors—19 types presented. Feature asbestos protection, lubriflush bearings, & normalized castings. Illustrated. U. S. Electrical Motors.
Motors 134	Feature extra insulation in stator slots & between phases, extra impregnations & bakings of the wound stator, greater care in fitting coils into stator, etc. Catalogue 676. General Dynamics Corp.
Motors L451	Use of motors result in the maximum in production, plant efficiency, quality and profit. Offer variable speed control needed. 20 p. illustrated Catalog 1-D-413. Sterling Elec.
Motors, Dripproof 494R	Advantages & operation in 16 p. More physical protection, better use of space, improved operating characteristics, etc. 1-30 hp ratings. Illustrated Bulletin GEA-6013. General Elec.
Motors, Enclosed 494S	Feature tougher insulation, less bearing maintenance, water-shedding stator coil, better rotor construction & performance, etc. Illustrated Bulletin GEA-6012. General Electric.
Motors, Explosion-Proof 355-6b	Illustrated bulletin covers totally-enclosed explosion-proof motors. Meet Underwriters' specifications & contain latest improvements for hazardous services: U. S. Electrical Motors.

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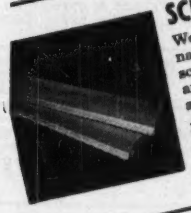

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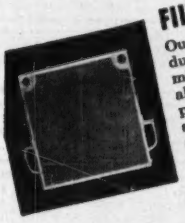

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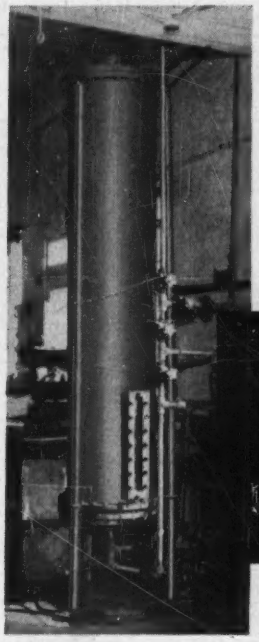

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Forest Hills Boston 31 Mass.

Technical Literature Now Available, *cont* . . .

Motors, Gear 496A
Descriptions of new maintenance, performance & protective features in illustrated 14 p. Double-spread cutaway drawing of motor. Superior design. Bulletin GEA-6027. General Electric.

Motors, Gear 167d
Gear motors from ½ to 15 H.P., single, double and triple gear reduction. From ½ to ½ H.P. refers to Bulletin 4-5P21-61. From 1 to 15 H.P. refers to Bulletin 4-1P31. Century Electric.

Motors, Polyphase 167b
Squirrel cage induction—½ to 400 H.P. (Bulletins 6-1P1, 6-1P3, 6-1P41, 6-1P45); Wound rotor—1 to 400 H.P. (Bulletin 6-3P1); Synchronous—20 to 150 H.P. (Bulletin 6-5P1). Century Electric Co.

Motors, Sanitary 155-6d
Advanced design meet all sanitary requirements. Immaculate, rustproof, with baked white enamel finish. Contains illustrations of motors in full color. U. S. Electrical Motors.

Motors, Single Phase 167a
Split phase induction—¼, ½, ¾ H.P. (Bulletin 1-5P1); Capacitor—½ to 20 H.P. (Bulletin 1-1P3); Repulsion start, brush lifting, induction —½ to 20 H.P. (Bulletin 2-1P1). Century Electric Co.

Motors, Syncrogear 155-6c
Bulletin describes internally-geared motors up to 30 h. p. Motors feature pyramidal design, hardened gears, sealed protection. 10 to 10,000 r.p.m. Illustrated. U. S. Electrical Motors.

Motors, Uniclosed 155-6f
Extra features in line of motors make for increased dependability. Streamlined, Uniclosed motors are weatherproof & drip-proof. Capacities to 250 h.p. U. S. Electrical Motors.

Motors, Varidrive 155-6a
Attainment of thousands of speeds by simple dial control. 2 to 10,000 r.p.m. Increase output. Motors quickly repay initial investment. Illustrated Bulletin. U. S. Electrical Motors.

Nozzles, Spray 496B
Nozzles available for every spray job. Used for acid chambers, air washing, chemical processing, cooling ponds, desuperheating, gas scrubbing, etc. Catalogs 6A & 6C. Monarch Mfg. Works.

Organic Chemicals 496C
Properties & uses for new chemicals: aleuritic acid, allyl cyanide, cantharidine, cerotic acid, lycopene, decacyclene, glucovanillin, indoxyl, pyrrocoline & 8-pentadecanone. Bios Laboratories.

Organic Chemicals 496D
Supplement lists 47 additions. Contains name of the chemical, its melting or boiling point, structural formula, molecular weight & price. Also removals & price changes. List 38-2. Eastman Organic Chem.

Ovens & Furnaces 496E
40 p. catalog on electric ovens, furnaces, glass annealing ovens, utility water baths, humidity cabinets & incubators. Used for drying, baking, preheating, tempering, etc. Blue M Electric Co.

Oxygen Recording 496F
Paramagnetic principle, how applied & how resulting signal is handled by recorder. Sampling unit described. Applications, performance, specifications. Folder ND46-91(2). Leeds & Northrup.

Packers, Bag 296
Cut packing costs—quickly fill self-closing bags to desired weight, save time in filling, eliminate need for sewing or other expensive bag closing equipment. E. D. Coddington.

Packing Compounds 236C
Self-moulding packing compounds for valves, pumps, expansion joints. Dispersion of pure copper flakes throughout body of stick shaped packing compound. Sizes cover most needs. Applications. Surveys, Inc.

Packings 496G
Folder on industrial rubber sheet packing. Contains important information on weight, tensile and hardness of rubber sheet stocks. Complete product line. Folder 853. Hamilton Rubber Mfg.

Packings, Metallic T235a
Geared to engineer or produce metallic packings & mechanical seals for refineries, chemical plants, pipe lines, ships, power, synthetic rubber & general industry. File No. FCE. Durametallic Corp.

Packings, Teflon 496H
Advantages of teflon packings & gaskets. Describes design, progressive action, economy, applications, pressure requirements, dimensions, etc. of seal rings. Halogen Insulator & Seal Corp.

Pans, Distributing 224
Cast iron distributing pans provide many advantages for more efficient water distribution over cooling & condensing sections. Easy installation & maintenance. Manual HT-20. National Radiator Co.

Papermaking 496I
24 p. outlines the properties of paper chemical products & describes use in papermaking. Includes resins & sizes & a brief history of development work in field. American Cyanamid Co.

Peroxygen Compounds 496J
For bright dips, metal cleaning, passivating & inhibiting. Involves steel, aluminum, brass, silver, stainless steel. Solution formulae, use, examples. Bulletin 51. Buffalo Electro-Chemical.

Pesticides 496K
Study in field of soil pesticide formulations. Discusses properties of company's granular carriers, and covers such matters as formulations, application techniques, etc. Attapulgus Minerals.

Phenol Handling 162-5a
32 p. booklet describes complete information on unloading tank cars, unloading small containers, sampling, transferring, storing, etc. Fully illustrated. Monsanto Chemical Co.

m-Phenols 337a
B.R.—207-230°C. Mixture of cresols, xylenols, & ethyl phenols—2.2 ortho & para positions per molecule are open. Phenol & 2,6-xylenol absent. Phenolic content—about 98%. Form 3107. Carbide & Carbon.

Phenols, High Boiling 337b
B.R.—230-270°C. Mixture of short-chain alkyl-substituted phenols—2.5 of three reactive ortho & para positions are open. Phenol & cresols absent. Phenolic content—98%. Form 3103. Carbide & Carbon.

Phloroglucinol 496L
Covers physical & chemical properties, occurrence & manufacture, specifications & standards, health & safety considerations, uses, derivatives & bibliography. 6 p. Ringwood Chemical Corp.

Pigments Iron Oxide 227
Reduce grinding & dispersing time & give brighter mass color, stronger tint, higher gloss, etc. Physical & chemical specifications & suggested applications. VVF Tech. Report. C. K. Williams & Co.

Pipe Couplings, Compression 496M
Explains use on cast-iron, steel & asbestos-cement pipe—threaded or mechanical joint. Components & applications. Photos, data on prices, sizes, etc. Folder 102. Morris Coupling & Clamp.

Pipe & Fittings 58-9d
For corrosion-resistant piping. Impervious graphite pipe & fittings readily installed, durable, easily maintained, resist corrosive fluids. Catalog S-7000. National Carbon.

Pipe & Fittings, Glass 420-1b
Designed for full-scale production operations. Strengthened by end-tempering, they feature corrosion-resistance, non-contamination, transparency, etc. Corning Glass Works.

Pipe, Fittings & Valves 270
Corrosion-resistant & durable, Saran lined steel pipe sharply cuts repair & maintenance costs in corrosive piping installations. Downtime cut to minimum. Easily installed. Saran Lined Pipe Co.

Pipe Installation, Glass 448-9a
Pipe is easy to install and low in installed cost compared with other corrosion-resistant materials. Available in 6 standard sizes from 1- to 6-inch I.D., inclusive. Corning Glass.

Pipe & Tubing T230
Stainless steel pipe, tubing and fittings from large stocks and a complete range of sizes. These products can meet needs for pressure or mechanical purposes. A. B. Murray Co.

Piping Layouts 273a
Planning an industrial waste treatment system. Description & enlarged diagram of practical piping layout with additional detailed data. Piping Layout 70. Jenkins Valves.

Piping Systems 496N
Contains more than 5,000 pressure-temperature ratings of various grades of pipe in common use in power plants. Ratings arranged for easy reference. Bulletin TB1-1953. Pipe Fabrication Institute.

Plastic Sheets 496O
Feature high impact strength, excellent dimensional stability, low moisture absorption, good heat resistance. Offer fast, low cost forming. Describes applications & specifications. Campco Div.

Plastics, Foamed 496P
28 p. with charts, graphs, photos, outlines uses, advantages, applications & physical properties. Includes stress, compression, tension, density, testing procedures, etc. Nopco Chemical Co.

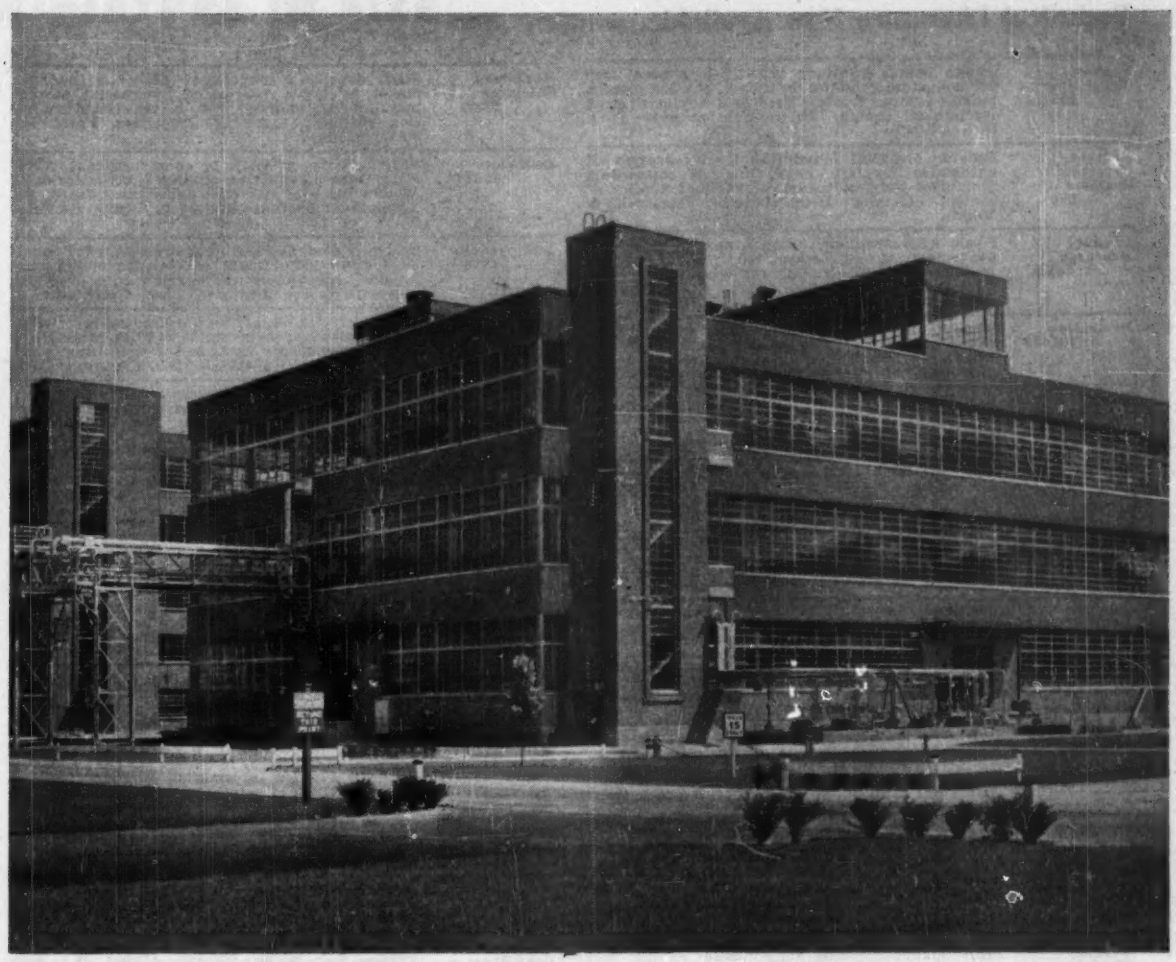
Plastics, Phenolic Molding 496Q
20 p. with properties, test values, molding techniques, applications. Five types—general purpose, improved impact, heat-resistant, low-loss electrical, special purpose. Booklet M-1. Bakelite Co.

Platecoils 143
For tank heating & cooling problems resulting from inefficient pipe coils. Take less tank space & save hours of downtime. 50% saving in heat transfer costs. Bulletin P61. Tranter Manufacturing.

Polyurethanes 496R
For adhesive applications. Lists raw materials & chemical reactions involved in adhesive system. Applications in other fields. Bond strengths, properties, etc. Bulletin P-151. Monsanto Chemical.

Power Systems 496S
Describes 15 applications of hydraulic & pneumatic power systems. Industries covered by applications include agricultural, canning, lumbering automotive, marine, etc. Illustrated. Rucker Co.

Presses, Filter 436
Size & design for every industrial filtration need. For use with filter bases of cloth, paper, metal screens, composition screens, etc. Choice of 6 closing devices. D. R. Sperry.



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Technical Literature Now Available, *cont* . . .

Presses, Tabletting 496T
Single punch & rotary tabletting presses used for compacting pharmaceuticals, powder metals, plastic preforms, etc. Describes applications & mechanical design. 21 p. Catalog 801. F. J. Stokes Mach.

Process Control Systems 396
Provide practical foundation for integration of automatic logging, monitoring & computing. Simplified communication & improved quality of control. Catalog 164. Manning, Maxwell & Moore.

Product Research 498A
Deals with development of a new product, improvement of an established product or the method of producing it, discovering new uses or a better raw material for it. 4 p. Arthur D. Little, Inc.

Propellers TR459
Smooth, vibrationless propellers for stirring, mixing, aerating, pumping, etc. Balanced to avoid whip & strain on shafts. Available in wide variety of metals & in sizes up to 60". Michigan Wheel Co.

Pumps 191a
Engineering bulletins offered on non-clogging sewage pumps, sump pumps, paper stock pumps, chemical service pumps, rubber-lined pumps, etc. Long-life features. Buffalo Pumps, Inc.

Pumps 279
For heavy-duty chemical service. Renewable shaft sleeve sealed to impeller head by superfinished joint. Bearing adaptors locked to shaft without setscrews. Bulletin P/1. Duriron.

Pumps, Centrifugal 267
Handles corrosive liquids. Now available in 8 different materials. Data on these new materials, performance curves, specifications & dimensions in Bulletin 726.3. Goulds Pumps, Inc.

Pumps, Centrifugal 498B
Impervious graphite pumps with capacities from 5 to 1500 G.P.M., armored connections, pump efficiencies to 60%, discharge pressures to 100 psi, etc. Catalog S-7250. National Carbon.

Pumps, Chemical Transfer 495
For continuous or intermittent light duty in transferring process chemicals. Mechanical shaft seals eliminate stuffing box troubles & shaft leakage. Bulletin B-1606. Peerless Pump.

Pumps, Controlled Volume 498C
Designed to provide accurate metering of clear liquids in minute quantities. Complete data on capacities, pressures, materials of construction & operating details. Bulletin 653. Milton Roy.

Pumps, Controlled Volume 149
Motor-driven controlled volume pumps feature long service life & precise liquid metering. Describes capacities, pressures, applications. Single or multiple units. Bulletin 553. Milton Roy.

Pumps, Filter 498D
Describes function, design & application of corrosion-resistant filter pumps. Covers filter pump equipment in 50-100 gal. per hr. range, for filtering corrosive solutions. 8 p. Sethco Mfg. Co.

Pumps, High Vacuum 33
How pumps combine simplicity of design, high volumetric efficiency & lowest operating costs to provide continuous service for all kinds of high vacuum processing equipment. F. J. Stokes Mach. Co.

Pumps, Piston-Diaphragm 243
Controlled-volume pumping of fluids. Applications, flow charts, specifications of models of various capacities & constructions. Inquiry Data Sheet. Bulletin 300. Lapp Insulator.

Pumps, Rotary 231D
Compact, economical, motor driven pump units. Range of capacities from 70 to 226 G.P.M. at 60 P.S.I. Each size has 3 interchangeable gear ratios. Sizes, capacities, etc. Bulletin 21. Geo. D. Roper.

Pumps, Rotary 93
Rotary gas ballast pumps help solve water vapor problems & maintain fast pump down time. Line of vane, piston-type & 2-stage pumps. Principle, construction & operation data. National Research.

Pumps, Sanitary 498E
Performance charts, operating data & conversion tables for determining correct sizing & capacities. Installation & usage. Covers suction, discharge, O-Ring seal, etc. 36 p. Waukesha Foundry Co.

Pumps, Self-Priming 328
Operate as positive air pumps during priming & then as regular centrifugal pumps. Pump liquids containing solids & abrasive matter in suspension. Bulletin 210-1. Lawrence Pumps.

Punches & Dies 498F
Illustrated brochure covers punch & die plant operations. Standard sizes & shapes in stock for quick delivery & every non-standard job custom made. 4 p. Arthur Colton Co.

Pyrometer-Controllers
Reduce rejects & improve product quality. Maintain even furnace temperatures despite changes in voltage or ambient. Accurate to ¾ of 1% of full scale. Bulletin GEC-713. Gen. Elec.

Pyrometers, Hand 498G
Uses & applications for portable instruments which measure temperature of any surface, liquid, gas or molten metal from 0 to 1600 F. Specifications & accessories. Bulletin GEA-6020. General Electric.

Radiation Instruments 498H
New automatic sample changer, mobile scintillation unit & an isotope analysis kit. Describes scintillation equipment & crystals, health safety equipment, radiochemicals. Professional Equip.

Radiation Shielding 224G
High density homogeneous alloy of tungsten, nickel & copper fabricated by special powder metallurgical methods. For use as efficient radiation shielding material. Properties. Form 6-9. P. R. Mallory.

Radiators 498I
Various types of radiator construction & materials. Data on radiator cooling, & other forms of coolers for use with oils, gases, air, water, etc. Application photographs. 24 p. Young Radiator Co.

Radiography 498J
Specially designed handling equipment for cobalt 60 sources. Directional & Panoramic Exposure Shields make gamma radiography safe, practical, inexpensive. Specifications. Tech. Operations.

Reactors 498K
For clarifying &/or lime softening of water. Major advantages of solids-contact principle, 3 basic requirements for sound design, illustration of basic types. Bulletin 5001-A. Cochrane Corp.

Receivers, Tank Gage 135
Remote reading for 36-ft. range tanks & smaller. Feature special design, increased efficiency, easy reading, flexible installation, etc. Bulletin CP-3004. Vapor Recovery Systems.

Recorders, Electronic 498L
8 p. technical data bulletin. Features simplified design, accuracy to ±1% of full scale, and self-starting operation from low energy sources. Robertshaw-Fulton Controls Co.

Reducers, Speed 111
Worm gear speed reducers feature safe, space-saving, right-angle drive, smooth torque flow and long-life efficiency—worm gearing improves with use. Catalog 400. Cleveland Worm & Gear.

Reducers, Speed 498M
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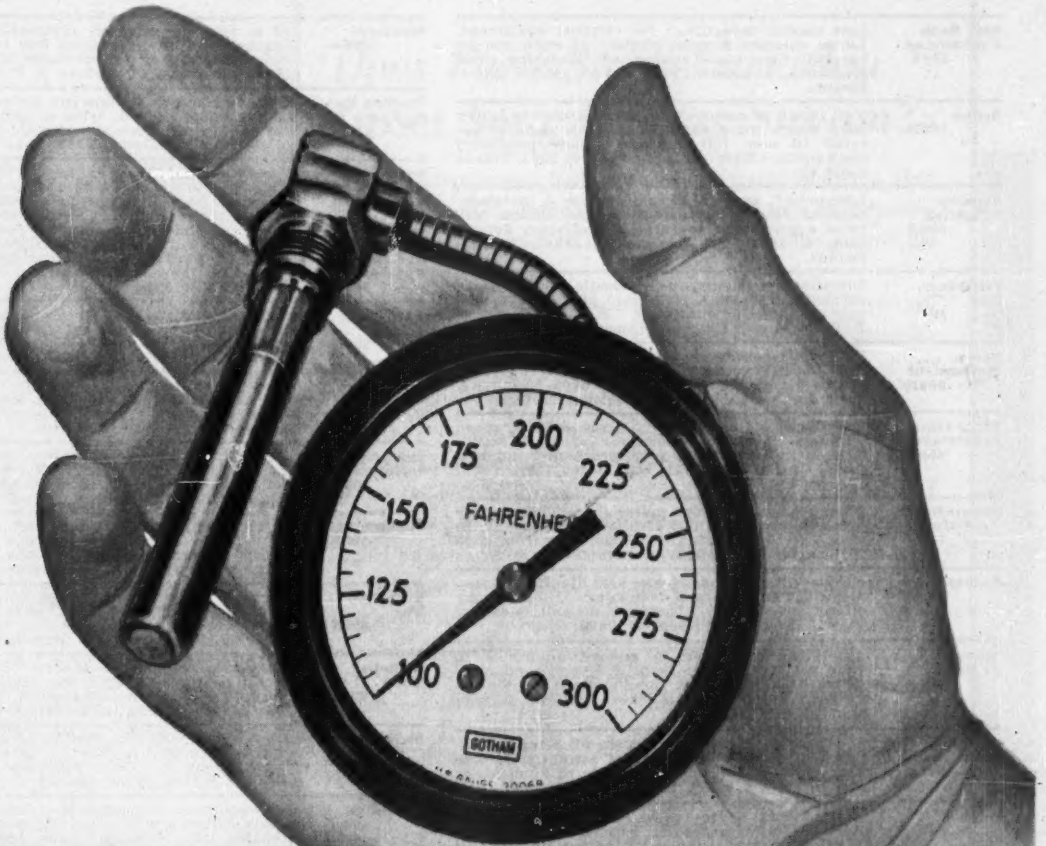

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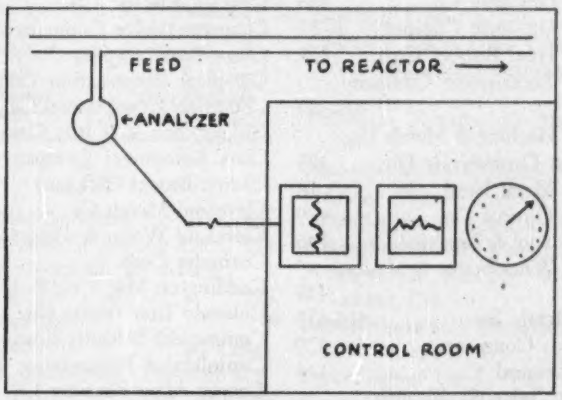

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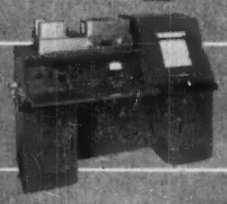

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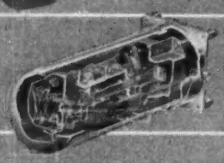

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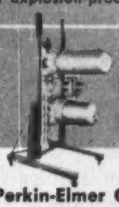

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Trays, Distillation 500BB — Revolutionary simple tray design for higher capacity at equal separation, lower pressure drop, longer tray life, easier maintenance. Capacities & advantages. Graphs. Shell Development Co.

Trucks, Die Handling 505A — Handle dies weighing up to 1½ tons. Electric, rider type, narrow aisle trucks for metal working shops. Installation photographs, specifications, dimensions. Bulletin 732-Z. Raymond Corp.

Trucks, Floor 505B — Pocket-size booklet illustrates 32 different types of trucks for easier and safer materials handling. Specifications, descriptions, sizes, etc. Booklet 53-S. Nutting Truck & Caster Co.

Trucks, Fork 505C — Electric powered, handling loads in confined areas at maximum speed. Compact & maneuverable. Applications, components, engineering drawings, design specifications, etc. Elwell-Parker Elec.

Trucks, Skid 505D — Installation photographs, specifications & dimensions. Describes a rider type, narrow aisle, electric powered truck for the handling of semi-live skids. Bulletin 718-X. Raymond Corp.

Tube Cleaning 234A — Spirally wound nylon brushes used with Jiffy Gun remove sludge or other soft deposits from small tubes as in condensers & heat exchangers. Operating photos. Bulletin Y-37. Elliott Co.

Tubes 238E — Armored group of long length tubes twisted together to permit bending without any distortion of tubes. Lower installation & original cost, etc. Crescent Insulated Wire.

Tubing, Aluminum 240 — Excellent on-the-job forming & flaring properties, available in economical lengths up to 1,000 ft. or more, has high resistance to most industrial atmospheres, etc. Aluminum Co. of America.

Tubing & Pipe 505E — Technical data on 14 tubing steels used in high-temperature or high-pressure service. Analyses, mechanical & physical properties, applications, etc. Folder TDC 163. Babcock & Wilcox Co.

Tubing, Rubber (Chart) 505F — 18 illustrations of amber & black tubing, giving inside & outside dimensions, physical properties, prices. Designed for maximum convenience & instant reference. Arthur S. La Pine & Co.

Tungsten Carbide, Cemented 505G — Describes advantages for balls & seats in subsurface pumps used in petroleum industry. Data on abrasion, corrosion, impact resistance, composition, manufacture. Bulletin B-100. General Electric.

Tungsten Carbide Components 505H — Manufactured in accordance with customer's specifications. Photos ranging from pieces as small as ½ gram to those weighing 18 lbs. Illustrate variety of shapes, sizes & forms. Sintercast Corp.

Turbines 48 — Turbines range from 150 hp down to fractional in 6 frame sizes. Feature large number of manually operated valves for individual control of steam nozzles. Bulletin 135. Coppus Engineering Corp.

Turbines, Mechanical-Drive 164-5 — Installation & maintenance cost-saving. Single reservoir for cooling lube oil; combined trip-throttle valve; interchangeable parts, etc. Bulletin GEA-4955A. General Electric.

Turbines, Mechanical Drive 392 — Simple, rugged, designed for long economical life & low maintenance. Feature true centerline casing support, replaceable governor, removable steam strainer. Bulletin 4206. De Laval.

Valve Charts 505I — Port & stop arrangements of Nordstrom multiport valves. Sketches of 4 types of multiport valves illustrate fluid traffic control obtained in various kinds of multiport valves. Rockwell Mfg. Co.

Valves, Control 505J — Air & hydraulic control valves. Sectional views of body, plunger, packing & interior operation. Lists sizes, actions, permissible pressures, temperatures, etc. Offers Bulletin 531. C. B. Hunt & Son.

Valves, Control 238C — Capable of completing an automatic control circuit involving extremely small flow rates at very high operating pressures. Illustrations, dimensions, specifications, etc. Bulletin 50WW. Annin Co.

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. . . Send me these reprints, I will remit on receipt. (See last Reader Service page for description.)

1 2 3 4 6 11 14 15 19 20 21 22a 22b 25 26 28 29 30 31 33 34 35 36 37 38 39

Valves, Control 506B	Feature single-seated, split-body with renewable seat ring & powerful springless diaphragm motor. Describes split-body construction, Cylinder Conomotor, operation, sizing, etc. Conoflow Corp.
Valves, Diaphragm Control 506A	Latest & most complete specifications. Prepared for users of diaphragm valves, it is of particular interest to the large user. 4 p. Bulletin BP-CVI. Delaware Valley Engineering Co.
Valves, Float & Lever 506B	Valves are balanced & tight closing. Applications, maximum capacities, operating pressures, temperatures, construction. Dimensions & wts. tables. Catalog 107. 15 p. Schade Valve Manufacturing.
Valves, Gate 255	Compact bolted bonnet design. No excess weight. Wider seating surfaces give higher resistance to seat corrosion & leakage. Sizes ½ to 2"; screwed, flanged or socket-welding ends. Crane Co.
Valves, Gate 228A	Self-cleaning valve provides impassable seal that shuts off bubble-tight. Suited for pipe line & production line use. Accepts A.S.A. & A.P.I. standards for pressures up to 10,000 lbs. Grove Regulator.
Valves, Solenoid 506C	Bulletin describes application, outstanding advantages, sizes & types, construction features, operation, prices & specifications. Diagrams of open & closed positions. Eclipse Fuel Engrg. Co.
Vermiculite Analysis 506D	Vermiculite's chemical & physical properties. Includes chemical composition, base exchange characteristics, solubility, water absorption, etc. Typical chemical & physical uses. Zonolite Co.
Vibrators, Pneumatic 506E	Operating photos show industry-wide usage. Line includes 29 mountings & 14 piston diameter sizes, capable of producing a wide range of vibration intensities. Catalog 109. Cleveland Vibrator Co.
Viscosity 506F	Viscosity of a new cellulose polymer compared to ½" R. S. nitrocellulose. Chart illustrating the comparison in a typical balanced solvents system are available. Eastman Chemical Products.
Waste Treatment BR458	Dry powder of preserved beneficial groups of micro-organisms accelerates natural biological action. Decomposes specific types of wastes. Used widely. Reliance Chemicals Corp.
Water Sampling 506G	Factors involved in getting useful samples needed for proper control of water conditions in a power house. Which samples are important, when taken, where obtained, etc. Allis-Chalmers Mfg.
Wetting Agents 102-3e	Processing aid in manufacture of superphosphates & fertilizer mixed-goods. Speed up reaction in manufacture by allowing more complete & quicker mixture of fertilizer ingredients. Monsanto Chemical Co.
Wire & Cable 506H	Describes uses & properties of aluminum for power & lighting wire. Tables cover insulation, current-carrying capacity, comparison of weights, breaking strength, etc. 30 p. United States Rubber Co.
Wire Cloth L495	84 p. catalog describes company's facilities for fabricating wire cloth parts. Includes wire cloth parts for screening, filtering & special uses. Useful metallurgical data. Cambridge Wire Cloth.
Wires, Extension B292	Long service for wires & less replacement cost. Keep accuracy by protecting wires from moisture & other hazards at temperatures as high as 600° F. Bulletin 31-E. Thermo Electric.
Wool Processing 506I	Use of chemicals in the many wet operations required to convert animal fiber into wide variety of useful end products. Prepare, dyeing & finishing of woolen & worsted fabrics. 36 p. Antara Chem. Div.
Worm Gear Sets 506J	Typical applications of double-enveloping worm gear sets & speed reducers in all types of food and chemical processing equipment. Illustrated. 4 p. Bulletin FCP-53. Michigan Tool Co.
X-ray Analysis 506K	Discusses crystallography & X-ray diffraction, identification of compounds, X-ray spectroscopy & microradiography. Illustrated with photographs & drawings. 12 p. North American Philips Co.
Zinc Concentrate Roasting 506L	New method of roasting concentrates for electrolytic or retort zinc production utilizing principle of fluidization. Operation & advantages of Fluo-Solids system. Bulletin 7501. Dorr Co.

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Flashback . . .

To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The listings on this and the following page is a repeat of the editorial listings only on chemicals, equipment and services featured last month in the New Equipment, New Products and New Technical Literature departments. Use the postcard below for more information on any item in this list.

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6-7a	34a	66-7d	88-9c	119	157	222C	231A	238F	265	T300	333A	348	395	439	487O	489I	492W	496R	500O	
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17b	45	74a	96e	134	166	224G	T235a	244	274-5b	310b	340	374	R410	455	488C	489Y	494O	498N	500C	
17c	46	74b	96f	135	167a	224H	T235b	244A	274-5c	312	340A	375	411	L457	488D	492A	494P	498O	500D	
17d	47	75	96g	137	167b	224I	B235a	244B	277	313	341	TL377	412-3a	R457	488E	492B	494Q	498P	500E	
17e	48	76-7a	97	138a	167c	225	B235b	245	279	314a	342A	BL377	412-3b	L458	488F	492C	494R	498Q	500F	
17f	49	76-7b	98	138b	167d	226A	B235c	245A	281	314b	342B	R377	414	TR458	488G	492D	494S	498R	500G	
18	52	76-7c	99	138c	167e	226B	B235d	245B	283	315	342C	378	415	BR458	488H	492E	L495	498S	500H	
19	53	76-7d	100	138d	167f	226C	B235e	246a	285	R316a	342D	379	416-7	459	488I	492F	496A	498T	500I	
20	54	76-7e	101a	138e	168	226D	B235f	246b	287	R316b	343a	380	418	461	488J	492G	496B	498U	500J	
21	55	76-7f	101b	139	217a	226E	236A	246c	288	R316c	343b	381a	419	462	488K	492H	496C	498V	500A	
22	56	76-7g	101c	141	217b	227	235B	246d	289-90	317	343c	381b	422	467A	488L	492I	496D	500A	500B	
23	57	78a	101d	142	217c	T228	236	246A	T292	318	343d	381c	423	467B	488M	492J	496E	500B	500C	
24	58-9a	78b	101e	143	217d	B228	236A	246B	B292	319	343e	381d	424-5	467C	488N	492K	496F	500C	500D	
25	58-9b	79	101f	145	217e	228A	236B	247	T294	320	343f	383	426	467D	488O	492L	496G	500D	500E	
26a	58-9c	80-1	101g	146	217f	228B	236C	248	B294	321	343A	384-5a	427	467E	489a	492M	496H	500E	500F	
26b	58-9d	82a	101h	147	218A	229	236D	249	T295	322	343B	384-5b	428	467F	489b	492N	496I	500F	500G	
26c	60	82b	101i	148	220A	T230	236E	254	B295a	324	343C	384-5c	429	467G	489A	492O	496J	500G	500H	
26d	61	83	103	149	220B	B230a	236F	255	B295b	325	343D	387	430	467H	489B	492P	496K	500H	500I	
26e	62	84-5	104	150	220C	B230b	237	256	296	326	345a	L390	431	467I	489C	492Q	496L	500I	500J	
27	63	86	107	151	220D	230A	238A	259	297a	327	345b	R390	434	467J	489D	492R	496M	500J	500K	
28	64	87a	108-9	152	220E	230B	238B	261a	297b	328	345c	391	435	467K	489E	492S	496N	500K	500L	
29	65	87b	111	153	221	T231a	238C	261b	297c	329	345d	392	436	467L	489F	492T	496O	500L	509	
30	66-7a	88-9a	113	154	222A	T231b	238D	262	298	331	346	393	437	467M	489G	492U	496P	500M	510	
32	66-7b																			

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212A	216A	216E	218B	220B	220F	224A	225C	226B	229B	233A	234B	338A	340C	333C	334A	336A	340A	342A	345B
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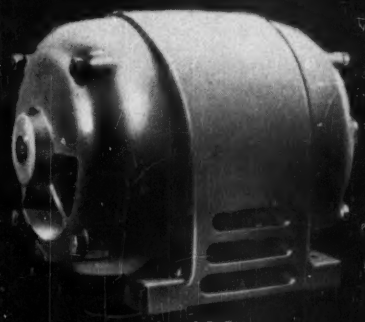

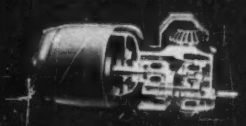

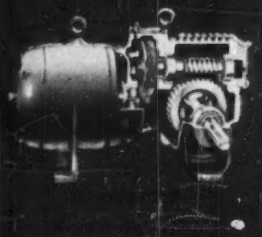

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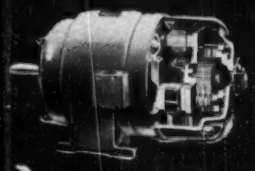

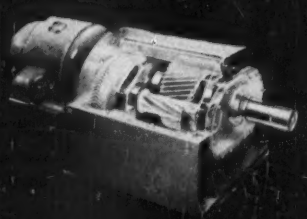

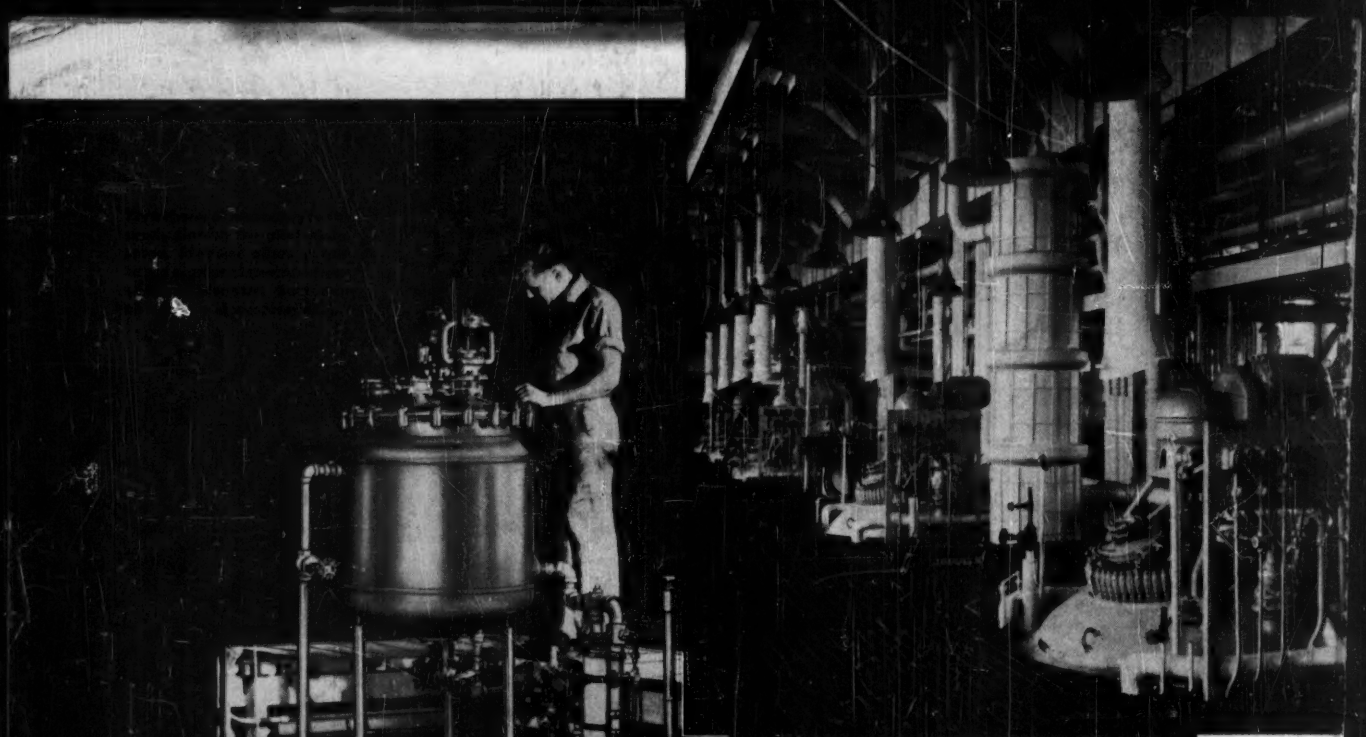

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